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The « Living Lab » concept:

Exploration and clarification of this a priori catchall term in the innovation landscape

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Abstract

Purpose of the thesis

The main objective of this thesis is to develop a clear understanding of the Living Lab concept in the light of the innovation landscape. In order to do so, the objective is to understand Living Lab's position compared to the broad concepts of open innovation and user innovation, to propose a new definition based on the Living Lab's nature and characteristics, to explore the mechanisms underlying the concept, to understand in which contexts Living Labs' projects can be implemented, and finally to get an overview on the main actions that can be implemented to foster the success of Living Labs' initiatives.

Confidentiality

The non-confidential aspect of this thesis is motivated by the will of the authors to contribute to the enlightenment of the Living Labs concept. In that view, this thesis is directed to Living Labs promoters and practitioners but also to novices in the field trying to refine their understanding of the a priori "catchall" concept. The public release of this thesis aims to make it available to any interested person. In parallel, the interviews conducted as part of this thesis were recorded with the approvals of M. Lomba, founder and instructor at Makilab Louvain-la-Neuve and M. Schuurman, team leader of the users expertize at Imec Living Lab. All data from the content of the interviews are non-confidential and can be used as reliable resources for further research.

Keywords – Living Lab, open innovation, user innovation, co-creation, public-private-people partnership, innovation process, fit assessment model, key success factors, Fab Lab, lead user, testbed.

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Introduction

The Living Lab, an innovation approach that has gained a lot of attention from European policy makers as well as innovation scholars since the mid-2000s (Levén & Holmström, 2008), provides novel structures for user involvement and opportunities of experimentation in real-life settings (Beutel, Jonas and Moeslein, 2017). Despite the growing interest towards those "living" ecosystems, there is not yet a clear understanding of this approach so far as numerous different definitions provide divergent visions of the same concept.

In this context, the main objective of this thesis will be to explore and clarify this concept in the light of the innovation landscape. For that purpose, the first objective is to look back at the concepts of open innovation and user innovation to discover the landscape in which this a priori "catchall" term has evolved. The second objective is to clarify the characteristics of the Living Lab concept and its nature in order to build our own definition. The third objective is to understand the underlying mechanisms of the Living Lab concept; namely the relationships taking place in this environment, the innovation process followed, and the methods and tools used. The fourth objective is the discovery of the fields of application and the contexts suitable for Living Labs' initiatives. Lastly, the fifth objective is to spot the main implications for the management when implementing and running a Living Lab.

Our methodology to achieve those objectives will be the following. Firstly, in order to position the Living Lab in the innovation landscape, we will explore the main characteristic of several innovation approaches and compare them to the Living Lab. We will also review the historical perspective of ENoLL in order to gather some additional insights. Secondly, we will gather numerous definitions from the Living Lab literature and select the ones that illustrate the main characteristics of Living Labs. Through the analysis of those definitions' components, we will select a defined set of characteristics and take position towards the Living Lab's nature. Those components will allow us to build our definition and define the boundaries of "what is a Living Lab". In addition, we will compare the Living Lab to three other innovation approaches; namely the Fab Lab, the testbed, and the lead user method, in order to understand "what is not a Living Lab". Thirdly, we will explore the literature on Living Labs to understand the key mechanisms underlying this concept. Fourthly, we will explore the Living

Lab practitioners' opinions in the scope of Living Labs and we will build our own fit assessment model in order to understand which fields of application and which contexts suit the most Living Labs, compared to Fab Labs. In addition, we will conduct two semi-guided interviews to test this fit assessment model empirically with Imec iLab.o and Makilab. Lastly, we will explore the literature to identify the main advantages and disadvantages, as well as the key success factors and risks associated to Living Labs. This will permit us to get an overview on the actions and practices that managers can implement in order to exploit the opportunities and overcome the challenges underlying Living Labs.

This thesis is divided into five main parts. The first one explores the Living Labs' forefathers through a literature review on the concepts of open innovation and user innovation, as well as the historical viewpoint of ENoLL. The second part will define "what is a Living Lab" and "what is not a Living Lab" through the exploration of the Living Lab's nature and characteristics, as well as the comparison with other innovation concepts. The third part explores how Living Labs works concretely by reviewing the main mechanisms, relationships, methods and processes taking place in Living Labs' settings. The fourth part reviews the literature regarding the types of projects and the sectoral profiles of Living Labs, and proposes a fit assessment model and an empirical testing of this one. Finally, the last part covers the main advantages, disadvantages, challenges, key success factors and risks related to the Living Lab concept.

Part 1 – The Living Labs' forefathers

Before defining the terminology "Living Labs", it is useful to understand how this concept was constructed and to seek from which influences the Living Labs were built. In order to do so, we will firstly base our reflection on a short literature review on the two broad concepts of open innovation and user innovation. By comparing insights from the literature on Living Labs with the characteristics of both the approaches of open innovation and user innovation, we will identify the main convergence and divergence points. We will finally consider the proposition of Schuurman, De Marez and Ballon (2013) to position the co-creation concept, as well as the Living Lab approach, between those two lines of thoughts. After the exploration of the Living Lab concept in the innovation landscape, we will look at the point of view of the European Network of Living Labs (ENoLL) in order to understand their opinion of the history of Living Labs. In this scope, we decided to split this part into two chapters. The first one takes a step backwards and looks at the origins of the Living Lab concept by digging into the broad concepts of open innovation and user innovation. The second one presents the Living Labs history as proposed by the ENoLL institution.

Chapter 1 – The innovation landscape

During the major part of the twentieth century, technological innovation was limited to a phenomenon happening within the boundaries of the firm. Based on a logic of vertical integration, R&D was conducted internally in a single company with a "do-it-yourself" approach (Chesbrough, 2003a). This internal innovation model, based on control and self-reliance, was viewed as a valuable strategic asset given the fact that knowledge was expensive and time-consuming to reach, which led to the emergence of "knowledge monopolies" (Chesbrough, 2003a; 2003b). This internal innovation process is illustrated in the work of Chandler (1962) that analyzes organizational innovation in the twentieth century through four case studies. Chandler's work showed that closed research laboratories expanded a pool of qualified scientists and engineers to develop their R&D processes exclusively in-house (Chandler, 1962; Chesbrough, 2003a). According to Bogers and West (2012), the vertically integrated innovation model relying on the internal control of innovations has actually been considered for a long time as one of the major reasons of the development of the modern industrial society (Bogers & West, 2012).

However, objections to this dominant view have arisen in the literature since the end of the 1980s, such as the work of Von Hippel in 1988 presenting studies attempting to understand the sources of innovation. In his work, case studies in the semiconductor and printed circuit board assembly process innovations and in the scientific instrument innovations showed that the source of innovation can come from outside of the firm. Also, by means of the analysis of informal know-how trading between competing firms, von Hippel (1988) conceptualizes the term "distributed innovation" as innovation happening outside the boundaries of the firm. Chesbrough (2003a; 2003b) clarifies the reasons why there has been a shift at the end of the twentieth century towards a new way to generate ideas and bring them to market. Indeed, internal R&D was progressively losing his status of "valuable strategic asset" due to several main erosion factors. As a matter of fact, the increasing availability and mobility of skilled workers, the expansion of venture capital since 1980, the shortening of product life cycles, and the extension of an external supply base contributed to the erosion of the closed innovation paradigm towards the emergence of the distributed innovation era (Chesbrough, 2003a; 2003b). According to the author, this shift rearranged the landscape of knowledge, where pools of information were now distributed across customers, suppliers, universities, etc. In this new landscape, the "do-it-yourself" approach was not adapted anymore given the fact that a great value could be captured outside the boundaries of the firm (Chesbrough, 2003a). Later on, von Hippel (2005) mentions this general trend towards the democratization of innovation in his work and states that this open and distributed innovation process is "driven by steadily better and cheaper computing and communications" (von Hippel, 2005, p. 177). Bogers and West (2012) add that this vision changes the previously used vertically integrated model towards cooperation across boundaries, value creation, performance improvement and economies of scale (Bogers & West, 2012).

In the scope of the distributed innovation processes, two main line of thoughts can be identified; the open innovation phenomenon, proposed by Chesbrough (2003a; 2003b; 2006; 2007; 2012), and the user innovation processes, outlined in the work of von Hippel (1976, 1977, 1988, 2002, 2005, 2007). In the next section, we will explore those two concepts in the objective of enlightening the innovation landscape.

1. Open innovation

In the landscape of innovation, we can consider that Chesbrough made an important contribution in the literature with the conceptualization of the open innovation concept in the early 2000s. In the work of Chesbrough (2003a), the concept of open innovation brings to light the economic opportunities derived from external innovation sources and it positions internal and external ideas at the same level of importance. Thus, it permits firms to commercialize external ideas by deploying external pathways to the market, but also to commercialize internal idea through external channels. In that view, this model enables innovation to move back and forth between a firm and its environment. The distributed aspect of knowledge in the open innovation paradigm makes external ideas available to use, and according to the author, the people at the origin of those ideas are similarly available for hire (Chesbrough, 2003a). Hence, a whole new range of opportunities take shape in the scope of open innovation. Indeed, selling internal research outputs, commercializing the external technologies, combining internal and external ideas to build to create new systems are examples among others (Chesbrough, 2003a). In 2006, Chesbrough defines open innovation as follows: “open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation” (Chesbrough, 2006, p.2).

As we explained in the previous section, several erosion factors were at the origin of the collapse of the vertically integrated model. Besides this, Chesbrough (2006) emphasizes on the fact that there is another important factor that boosted the process of open innovation; the rising cost of technology development in many industries. Combined with the shortening of life cycles, it thus became more and more difficult to invest in internal innovation and this called for the opening of business models. Indeed, according to the author, both effects can be addressed; on the one hand, costs can be reduced by relying on external R&D, and on the other hand, revenues can be increased by licensing technologies internationally for example. Therefore, firms will be able to exploit those external opportunities and benefit from this new open approach only by opening their business model. By integrating external sources of knowledge in the business model, firms can leverage more ideas and capture a greater value by making use of the key resources and competences of other firms’ businesses (Chesbrough, 2006).

In exploring different ways of exploiting external resources and competences, many companies have decided to rely on either the funding of innovation, or on the generation of innovation, or on the commercialization of innovation (Chesbrough, 2003b). When it comes to fund innovation, there are two main players; investors and benefactors. On the one hand, Chesbrough (2003b) states that investors provide the necessary financial help and advices to move ideas into the market generally through the creation of startups. On the other hand, benefactors intervene at the early stages of the research discovery in order to look at the ideas and selectively fund those that seem the most promising ones (Chesbrough, 2003b). Concerning the generation of innovation, Chesbrough (2003b) identifies four types of organizations; innovation explorers, merchants, architects and missionaries. While innovation explorers focus on the discovery research stage for the innovation's sake, innovation merchants' main objective is to codify a narrow set of technologies into intellectual property that could be commercialized. The innovation architects will focus on the elaboration of a complex technology that could be later on portioned into several pieces and licensed, such as the Boeing 747 from which companies produce the constituent parts. Finally, innovation missionaries will develop technologies essentially to serve a specific cause that motivates them (Chesbrough, 2003b). The last mode of innovation is the commercialization, where organizations can be innovation marketers or one-stop centers. While the innovation marketers focus of the market needs' analysis to identify the best offer, innovation one-stop centers will focus on the customer relationship and the best way to facilitate the customer's experience (Chesbrough, 2003b).

When we look more specifically at the types of open innovation practices, Bogers and West (2012) state that open innovation relies mainly on revenue-generating practices through the involvement of various external stakeholders acting as valuable sources of knowledge, such as suppliers, customers, competitors and universities. Such practices can be used at different stages of the innovation process. Indeed, Lapointe and Guimont (2015) mention that during the exploration phase, the open innovation practices cover external networking, user involvement, R&D outsourcing, acquisition of intellectual property and external investments. At the exploitation phase, new options arise, such as joint ventures, employees' involvement, and the use of patents, royalties or trademarks (Lapointe & Guimont, 2015).

Since the conceptualization of the open innovation concept in the early 2000s, the idea of collaboration underlying the open innovation concept has evolved to a certain extent. When looking back at the first papers published on the subject, Chesbrough (2012) argues that collaboration in the scope of open innovation generally happened between two organizations in the early 2000s, but it is more and more moving towards an approach orchestrating collaboration between a significant number of players across multiple roles in the innovation process. According to him, “designing and managing innovation communities is going to become increasingly important to the future of open innovation” (Chesbrough, 2012, p.26). This illustrates an ongoing trend towards the participation of several stakeholders at different stages of the open innovation process.

In this section, we gathered many insights regarding the open innovation model and its economic opportunities. Under this new era, organizations take advantage of the external knowledge and make use of their internal knowledge externally to develop new opportunities of value creation. In the next section, we will discover another facet of the innovation landscape through the exploration of the user innovation model, pioneered by the work of von Hippel (1976, 1977, 1988, 2002, 2005, 2007).

2. User innovation

Prior to the conceptualization of the open innovation concept, von Hippel explored the opportunities underlying the involvement of users in the innovation process. His work on the dominant role of users in the scientific instrument innovation process in 1976 pioneered the user innovation approach. By exploring the role of users and manufacturers through eleven cases studies where the commercialization was significantly successful, von Hippel found that about 80% of those successful innovations offered a significant increase in functional utility to the end-user, and that those innovations were not developed by an instrument manufacturer, but rather by the users themselves (von Hippel, 1976). By conducting studies in other industries in 1977, von Hippel discovered that user innovation also occurred in the domains of semiconductor manufacture and electronic subassembly manufacture, with a proportion of 67% of the major process equipment innovations invented, prototyped and first field-tested by users (von Hippel, 1977a). In his work, von Hippel also characterized the pattern of user-dominated innovation activities. According to him, if the initial user of an industrial product detects the need for this specific product innovation, designs the solution, creates a

prototype, tests the value of the product and finally discloses detailed information about the product's value and the possibility to diffuse it to other users through manufacturing; then the innovation activity is considered as user-dominated (von Hippel, 1977a).

Next, von Hippel goes a step further and gathers a significant number of information and studies providing empirical data on the source of successful innovations in 1977. Those data came from diverse sources, such as searches of journals and patents, interviews with expert users and manufacturers, as well as interviews with employees who first manufactured an innovation to be commercialized (von Hippel, 1977b). One of his first observations was that the user seemed to be the most frequent source of innovation by building home-made solutions for specific needs before the availability of a commercial version of this solution in the market. This thus rejected the previously leading assumption among practitioners, which was that the role of users in the innovation process was restricted to have needs and share them with manufacturers by means of market research (von Hippel, 1977b). Nevertheless, it has to be said that the role of user in the innovation process varies significantly among industries. Based on von Hippel's statistics (1977a; 1977b; 1988), we observe that the user role in the innovation process is lower in tractor shovel-related innovations, chemical additives for plastics, wire termination equipment, engineering plastics and computer innovations. In contrast, users seem to be more involved in the following innovation categories: pultrusion processing machinery innovations, scientific instruments, semiconductor and printed circuit board process, chemical processes and process equipment available for license, industrial gas-using and thermoplastics-using (von Hippel, 1977a; 1977b; 1988).

By exploring the causes of this difference in the level of user involvement amongst industries, von Hippel (1977b) proposes two main hypotheses. The first one states that users carry out new product innovations at the beginning of a new product area, as they understand their own needs better than manufacturers; but needs become more and more known and well-defined over time, which results in a shift of the innovation from the users to the manufacturers. This first hypothesis has been partially validated via empirical tests, but is not considered as sufficient to explain the high or low presence of user involvement in specific industries. The second hypothesis states that investment in innovation is a function of the expected return from that innovation (von Hippel, 1977b). Thus, we understand from this

second hypothesis that user-dominated industries would be characterized by users expecting to benefit more from the innovation outcome than manufacturers. This hypothesis will be later confirmed by Morrison, Roberts and von Hippel (2000), who argue that "the greater the benefit an innovator expects to obtain from a needed novel product or process, the greater will be his investment in obtaining a solution" (Morrison, Roberts & von Hippel, 2000, p.1519). In this scope, the authors propose two variables likely to increase the frequency of innovation by users. The first one is the expectation of getting a significantly attractive amount of profit from the innovation development, and the second one is the level of stickiness of the local information, or in other words, the fact that valuable information that would be used to develop a new product or service is costly to transfer (Morrison, Roberts & von Hippel, 2000).

When we look at the implications for firms in user-dominated industries, von Hippel (1977b) recommends them to organize their innovation effort differently by switching from manufacturer-sourced to user-sources innovation activities. According to the author, this can be done through the consideration of three main changes: (1) the shift from the marketing research aiming to analyze needs and develop new product concepts, to the exploration of user prototypes and user utility related to those potential new products, (2) the new missions of the sales force to get information on user prototypes, and (3) the new R&D process oriented towards product engineering work on user prototypes (von Hippel, 1977b). Indeed, von Hippel (1977c) argues that if market researchers focus on looking for users' needs only, they could miss valuable data on product design, as information about the needs for a new product and about the product design are often bundled together (von Hippel, 1977c). In that view, toolkits for user innovation can be useful tools to focus on the need-related aspects of a new product or service. Indeed, toolkits are pioneering tools that emerged in the 1980s to move away from the traditional marketing search aiming at understanding user needs in detail. By allowing users to develop a product via iterative trial-and-error, they give more freedom to users but they still guide them to ensure the compatibility with the current production system (von Hippel, 2002; Bergvall-Kåreborn, Björn, & Chincholle, 2011). Also, it has been shown that the user's satisfaction is significantly higher when users are free to innovate for themselves and build what they want (von Hippel, 2007). It thus means that restricting users to a limited set of innovation options can be counter-productive for the innovation process. In addition, an interesting insight for market researchers is that "information about new product needs in some industries prove to come consistently from the same type of source in case after case"

(von Hippel, 1977c, p.866); market researchers could therefore save time and money by using those sources of information more efficiently (von Hippel, 1977c).

However, when market researchers are looking for needs for a new product and for the product design, they may experience some difficulties. von Hippel (1988) outlines this difficulty and states that the users' needs and insights concerning new products might be constrained by their real-world experience. Hence, their familiarity with the current product offering can prevent them to detect new product needs falling outside of their real-world experience. The author argues that typical users influenced by their current experience can play a valuable role in slow-moving industries, such as the automotive industry, but their contribution is not sufficiently "new" to be used in fast-moving industries. For such industries, like the high technology industry, market researchers need the contribution of users who are familiar with conditions that are not rooted in the present, but lie in the future. Indeed, as the need for a new product frequently diffuses through a society over many years, some users are impacted before others and express needs that are not yet present in the whole society (von Hippel, 1988). von Hippel (1986; 1988) thus introduces the concept of "lead users", who represent users displaying two main characteristics: (1) they face needs that will be general in a marketplace months or years later, and (2) they would benefit significantly from obtaining a solution to those needs (von Hippel, 1986; 1988). This last condition goes along with the previous hypothesis of von Hippel (1977b), stating that user-dominated industries would be characterized by users expecting to benefit greatly from the innovation outcome. Hence, those lead users are considered as a valuable source of information for new product concepts, needs and design data for manufacturers (von Hippel, 1988). In this context, von Hippel developed the lead user methodology, that will be explained later in this section. Urban and von Hippel (1988) precise that lead users can come up with attractive user innovations themselves to meet their leading-edge needs which cannot be satisfied by commercially available products in the market (Urban & von Hippel, 1988). Thirty years later, we retrieve the same way of thinking from Schuurman and De Marez (2017) who define lead users as early users at the forefront of a trend, with a strong interest in innovating for themselves. They are consumers, customers or users who are amongst the first to adopt a service or product, and who express very early on a need for which there is not yet a solution. Dell'Era and Landoni (2014) argue that "lead users differ from opinion leaders by determining functional and semantic changes to traditional products at a functional level and proposing previously

unknown market solutions" (Dell'Era and Landoni, 2014, p.142). On an empirical viewpoint, many studies have confirmed the attractiveness of the innovations reported by lead users in terms of commercialization (von Hippel, 2005). Moreover, thanks to the continuously improving quality of computer software and hardware, as well as the improved access to easy-to-use tools for innovation, the ability of users to innovate is increasing drastically (von Hippel, 2005). This illustrates the increasing importance of user involvement in the innovation process.

Nowadays, we also observe that lead users can be valuable sources of information from inside the company. Indeed, in their article, Schweisfurth and Raasch (2015) propose a specific type of lead users that they call "embedded lead users". The authors define embedded lead users (ELUs) as "employees who are lead users of their employing firm's products or services" (Schweisfurth & Raasch, 2015, p.169). The authors argue that ELUs are dually embedded in the firm and in the use context which is likely to affect their cognition and organizational behavior. Hence, embedded lead users present several benefits: (1) ELUs are more customer-oriented and thus more effective at acquiring need information, (2) ELUs are also more active in internal boundary spanning and disseminating market information within the firm, and (3) ELUs undertake more innovation effort than regular employees, utilizing market need information for product innovation (Schweisfurth & Raasch, 2015).

Nevertheless, by comparing the user innovation approach to other line of thoughts, Bogers and West (2012) explain that user innovation is different from other approaches in the sense that it investigates the functional relationship between the actor and the innovation. While open innovation research is mainly interested in innovation advantages at a company level, such as costs reduction and commercialization opportunities, the user innovation stream focuses on the conditions under which the users can bring knowledge in order to innovate. Also, user innovation differs from other innovation initiatives because the questions and the results focus on the utility gains for the user rather than on pecuniary advantages. Nonetheless, commercializing possibilities for external innovations developed with the involvement of the end-users could exist for profit seeking firms too (Bogers & West, 2012). The Appendix 1 summarizes the key differences between the three innovation models we previously explained: (1) the vertically integrated innovation model, (2) the open innovation model, and (3) the user innovation model.

After having reviewed the main components of those three line of thoughts, we will now look deeper at the level of user involvement in user innovation processes. Depending on the user innovation methodologies, the level of user involvement can vary from a passive to a more active role in the development of new products and services. In that view, Almirall, Lee and Wareham (2012) propose to break down the user innovation model into many different categories of user involvement that will be presented hereafter: (1) user-centered innovations, (2) design-driven innovations, (3) participatory design, and (4) user-driven innovations. The authors classified those four categories according to their level of user involvement, from the lowest level where users are considered as subjects of observation, to the highest level where users are recognized as co-creators (Almirall, Lee & Wareham, 2012). Within each of the four categories, insights from the literature will be presented to understand the four different levels of user innovation, and each category of user involvement proposed by Almirall, Lee and Wareham (2012) will be illustrated by some selected innovation methods in the next sections.

2.1. User-centered innovation methods

In the first category, users have a passive role in the innovation process, they are considered as subjects of study that should be observed. Dell'Era and Landoni (2014) state that unique insights can be identified by asking about user needs, observing users during the use of existing products or tracking user behavior during consumption process (Dell'Era & Landoni, 2014). This is mainly the case for usability testing, human factors, ergonomic or applied ethnography (Almirall, Lee & Wareham, 2012). Various other methods have emerged in the scope of user-centered design, such as contextual design, where users are observed in their real-life environment (Bayer & Holtzblatt, 1998), or experience design, which rather focuses on the quality of the user experience (Aarts & Marzano, 2003). Hereafter, applied ethnography and testbeds will be presented in the scope of user-centered innovation methods.

As part of the user-centered innovation scope, applied ethnography is an innovation method adapted from the anthropology domain in which the central assumption relies in the fact that customers may not always be aware of certain aspects concerning their interactions with the product or service and thus cannot express clearly their needs related to the product/service (Dell'Era & Landoni, 2014). Applied ethnography can be defined as the

practice of observing users in the context of use (Sanders, 1992; Ball & Ormerod, 2000). Moreover, Dell'Era and Landoni (2014) state that "applied ethnography consists of the observation of relationships between different actors in a natural context to gather the meaning attributed to the phenomenon and different points of view" (Dell'Era & Landoni, 2014, p.142). Hence, it is important to understand that applied ethnography does not explicitly identify consumer needs but rather identifies the symptoms of unexpressed needs, such as frustration, confusion, unexpected use, etc. (Kotler & Scott, 1999). In other words, applied ethnography is about learning from people rather than studying people (Spradley, 1979). This method presents advantages by uncovering "insights on important aspects of human activity which more scientific techniques tend to miss (e.g. behaviors that arise at the social interface or behaviors which may not be directed towards the attainment of organizational or managerial goals)" (Ball & Ormerod, 2000, p.5).

Also in the scope of user-centered innovation, testbeds are controlled environment where the users can test innovations under development and provide their feedback. In contrast with the applied ethnography method previously presented, testbeds are materialized into physical or virtual facilities. Those facilities enable "companies or researchers to develop and systematically test new and innovative solutions such as interfaces, apps and products and their associated business models" (Dahlerups, 2014, p.1). According to Dabberdt et al. (2005), a testbed can be defined as "a working relationship in a quasi-operational framework among measurement specialists, forecasters, researchers, private sector, and government agencies, aimed at solving operational and practical regional problems with a strong connection to the end-users" (Dabberdt et al., 2005, 970–971). Described as a controlled experimentation platform, a testbed performs several activities, such as the implementation of scenarios, the production of testable outcomes to validate the conformity of the implementation, the exploration of new technologies, and the creation of new products and services (Object Management Group, 2017). Dahlerups (2014) argues that this kind of initiative permits entrepreneurs, star-ups and SMEs to test and adapt their product or service to the market. Such testing and market validation can reduce the time and costs dedicated to testing and increase the probability of market adoption (Dahlerups, 2014). Moreover, a testbed environment could serve as place where "novel measurements could be prototyped, applications could be developed, and commercial solutions could be pursued" (Koskinen et al., 2011, p.325).

2.2. Design-driven innovation methods

After having reviewed the user-centered innovation methods, the second category of user innovation proposed by Almirall, Lee and Wareham (2012) is the design-driven innovation. Here, designers take the lead to develop innovation in contexts where the subjective meanings that people give to products is emphasized (Battistella, Biotto and De Toni, 2012). The design-driven innovation model was proposed by Verganti (2008) who defines it as "a strategy that aims at radically changing the emotional and symbolic content of products, i.e. their meanings and languages, through a profound understanding of broader changes in society, culture and technology" (Verganti, 2008, p.2). This idea relies on the fact that a product is not only represented by its form or function, but also by its meaning for the customers (Battistella, Biotto & De Toni, 2012). Hence, "the introduction of radical design-driven innovations requires the development of several channels to access tacit and distributed knowledge about socio-cultural trends" (Dell'Era & Verganti, 2009, p.3). Moreover, being part of a network is recommended in order to facilitate stakeholders' interactions and knowledge sharing (Dell'Era & Verganti, 2009). In the scope of building knowledge, the role of the designer is crucial in the process of sensing and foresight (Borja de Mozota, 2003). Verganti (2008) add that the designer should act as a "broker of knowledge on languages and not only on technology" (Verganti, 2008, p.36). By capturing, recombining and integrating knowledge about different socio-cultural environments, designers support companies in the creation of breakthrough product meanings (Krippendorff, 1989; Lloyd & Snelders, 2003; Verganti, 2003; Durgee, 2006). The main difference between the user-centered innovation approach and the design-driven innovation approach is that while innovation is pulled by user requirements in the first approach, innovation is mainly pushed by firms' visions on potential new product meanings and languages through society in the second approach (Dell'Era & Verganti, 2009).

To illustrate the design-driven innovations, we will present quickly three specific techniques used in the scope of design-driven innovation applied in a service design project, referred as DDSI (design-driven service innovation). According to Takeyama et al. (2016), the first technique, called "contextual reframing", is used when different contexts are investigated in order to find new meanings for a certain service. In other words, the objective is to find a socio-cultural context related to the original one where new meanings of the service can be developed. In this scope, looking at potential customers who are not currently using the

service and the reasons why they are not using it could be helpful to find a context where new meanings of the service can arise. The second technique, called “structural interpreting”, is used for “supporting the ideation of a new service concept based on the insights collected through the design discourse with key interpreters” (Takeyama et al., 2016, p.6). Hence, this technique proposes a structural framework assisting the design team to evaluate if the new meaning of the product is drastic and suitable in the context investigated. Lastly, the third technique, called “contextual blending”, is used to integrate the new vision of the service experience within another activity context. This technique aims to support the shift of contexts and meanings to exploit the service from another angle (Takeyama et al., 2016). According to the authors, those three techniques provide “the procedure to transform the current meaning of a service into a new meaning of the service that reflects an interpreter’s unique perspective on the reframed life context” (Takeyama et al., 2016, p.10).

2.3. Participatory design innovation methods

After having reviewed the user-driven and design-driven innovation methods, the third category proposed by Almirall, Lee and Wareham (2012) is the participatory design innovation. According to Dell’Era and Landoni (2014), participatory design methods attempts to actively involve multiple stakeholders, including employees, partners, citizens and users, in the design process to ensure that the final product will be usable and meet their needs. The stakeholders co-operate with designers, researchers and developers during several stages of the process, from the initial exploration and problem definition, to the development and evaluation of solutions. As opposed to users studied in the two previous approaches, users in participatory design are aware of the development process as they are invited to participate and contribute to the development of new products and services (Dell’Era & Landoni, 2014). Mulder and Stappers (2009) also propose to actively involve users by setting generative techniques in order to engage more and more the users as co-creators. The authors add that the concepts of co-creation and co-design had been growing within the participatory design landscape (Mulder & Stappers, 2009).

As an example, the Scandinavian method takes place within the boundary of the participatory design approach and distinguishes itself on three principles: (1) democracy and democratization, (2) values in design, and (3) conflict as a resource in design (Gregory, 2003). Among those three principles, the desire and the ongoing motivation to increase workplace

democracy has been culturally and politically anchored in Scandinavia (Bjerknes & Bratteteig, 1995). Scandinavian participatory design is also known as the Collective Resource approach (Bjerknes, Ehn & Kyng, 1987; Kyng, 1998). Talking about the Collective Resource approach, Bjerknes et al. (1987) already emphasized the aim of "democracy and skill for the workers, using the collective—the trade union—as a strategy to achieve this" (Bjerknes, Ehn & Kyng, 1987, p.56). In conclusion, the Scandinavian participatory method focuses on expanding working life democracy by including the workers' influence at the societal level and allowing all employees to participate in decision-making about their work and how it is changing (Gregory, 2003).

2.4. User-driven innovation methods

The last category of user innovation proposed by Almirall, Lee and Wareham (2012) is the user-driven innovation. Here, Dell'Era and Landoni (2014) explain that users are at the center and drive the innovation process by leveraging on their own knowledge and skills to proactively propose new solutions. The role of the designer is therefore to translate the users' propositions into robust solutions in order to address their needs. Compared to the participatory design methods, users have specific skills or knowledge of the technologies and can therefore have a more proactive role (Dell'Era & Landoni, 2014). In particular, the lead user method is under the scope of design-driven innovations. Hereafter, the lead user methodology as well as Fab Labs will be introduced as illustrations of user-driven innovation methods.

As we previously mentioned, the lead user methodology has been introduced and theorized by von Hippel in the 1980s after having identified the lead users as valuable sources of information for the creation of new products and services. Following the work of von Hippel (1986), the lead user methodology can be declined into four basic steps: (1) the identification of an important technical or market trend, (2) the identification of lead users in that market trend, (3) analysis of the lead users' needs and innovation development, and (4) testing and validation of the innovation in the market (von Hippel, 1986). Schuurman and De Marez (2017) add that the user leverages on his deep knowledge and skills to proactively propose a potential solution, which the designer has to translate into a robust solution that can address the market needs. The lead user methodology presents several benefits well described by Dell'Era and Landoni (2014). The authors state that "in addition to allowing the company to acquire

articulated and reliable information about consumer needs, this method obtains information about desired characteristics and performance during the first phases of new product development" (Dell'Era and Landoni, 2014, p.143). Moreover, "this method discovers potential problems before the market launch of the product and offers the company the possibility to proactively remedy a problem in the market" (Dell'Era and Landoni, 2014, p.143). Nevertheless, the lead user methodology is not restricted to the first phases of the innovation process. Schreier, Oberhauser and Prügl (2007) confirm that the lead user methodology is a valuable resource for the development of new products but they also emphasize the benefits of the method for the adoption as well as the diffusion of new products. First, the authors share the view that lead users possess strong domain-specific innovativeness facilitating the development process. Second, the authors argue that lead users perceive breakthrough technologies as less complex than ordinary users, which make them therefore better prepared to adopt new usages. Third, the authors state that "lead users demonstrate stronger opinion leadership and weaker opinion tendencies" (Schreier, Oberhauser & Prügl, 2007, p.16). Hence, the lead user methodology might play an important role in development, adoption and diffusion of new consumer products thanks to the different contributions of the lead users (Schreier, Oberhauser & Prügl, 2007).

After having gathered some insights about the lead user methodology, we will explore briefly a newer concept that is also derived from the user-driven innovations; the Fab Lab. Contraction of "fabrication laboratory", a Fab Lab is a physical place giving access to a variety of digital manufacturing technologies to people and entrepreneurs who can turn their ideas into new products or prototypes (Gershenfeld, 2005). Proposed by Professor Gershenfeld from the MIT, the idea is to democratize the design, prototyping and object making processes. In other words, Fab Labs are meeting spaces where collaborative creation is made possible. Fab Labs "offer access to a range of low-cost fabricators and they are based on a commons-based peer production approach" (Troxler & Wolf, 2010). Mikhak et al. (2002) emphasize that the core idea of this concept is "the belief that the most sustainable way to bring the deepest results of the digital revolution to developing communities is to enable them to participate in creating their own technological tools for finding solutions to their own problems" (Mikhak et al., 2002, p.1). The main characteristic of Fab Labs is their "openness". They are intended to entrepreneurs, designers, artists, handymen or students of different populations, age groups and professions who want to move faster through the innovation process. The difference

between Fab Labs and similar projects already existing relies in the fact that Fab Labs are a network based on breakthrough physical production methods and accessible tools allowing manufacture to the individual level (Diez, 2012). Indeed, one of the objectives is to give public access to tools and machines to observe the use that would be made of them without academic constraints (Makilab, 2017).

Now that we found out a little bit more about the four user innovation methods classified by Almirall, Lee and Wareham (2012), we understand that many concepts underlie the user innovation framework. As a matter of clarification, the Table 1 summarizes the four models of user involvement and the role users play in the development process. From that table, we see that depending on the method used, the user will be more passive or active.

Table 1 - Comparison of the main methods of user involvement in the innovation process

	User role	**Level of user involvement**
User-centered	Passive subjects of study	Low
Design-driven	Passive users as the designers take the lead in the innovation process	Low to moderate
Participatory	Users on equal ground with other participants	Moderate to high
User-driven	Users drive the innovation process	High

Sources: Almirall, Lee & Wareham (2012); Dell'Era & Landoni (2014)

After having reviewed the literature on open innovation and user innovation as well as having learned about different user innovation methods, the next section will explore the position of the Living Lab within this innovation landscape.

3. Living Labs as a bridge between open innovation and user innovation

In this section, we will explore the elements that make the Living Lab concept converge with the open innovation approach on the one hand, and with the user innovation approach on the other hand. Then, we will develop further the proposition of Schuurman, De Marez and Ballon (2013) to position the co-creation concept, as well as the Living Lab approach, between those two lines of thoughts.

When we look at internal and external knowledge exchanges, we observe in the literature that many external resources are pooled in Living Labs settings. Indeed, Schaffers et al. (2007) argue that Living Labs rely on agreements between different partners, such as companies, researchers and customers, which bring together a significant collection of assets, including knowledge, user communities, infrastructures, technologies, etc. (Schaffers et al., 2007). In that view, the Living Lab approach can be seen as human-centric, given the fact that it considers individuals as key sources of knowledge and information valuable for research and development activities and thus involves them at different stages of the innovation process (Levén & Holmström, 2008). The authors add that the Living Lab can answer the opportunities identified in the open innovation approach by bringing together a heterogeneous set of actors with different needs, such as organizations, researchers, students, etc., in the objective of delivering new knowledge and innovations to the actors involved (Levén & Holmström, 2008). Built on voluntary collaboration, each participant is considered to have the same importance and relevance (Leminen, Westerlund & Nyström, 2012). Hence, the role of Living Labs is to orchestrate the different stakeholders' relationship throughout the whole innovation process, like an innovation intermediary (Almirall & Wareham, 2011).

We thus observe that the Living Lab concept is in line with the open innovation approach as Living Labs rely on the idea that external sources of knowledge are a valuable resource for innovation purposes. Moreover, the assimilation of Living Labs with innovation intermediaries proposed by Almirall and Wareham (2011) matches the work of Chesbrough (2006) on open innovation. Indeed, the author already mentioned the rise of innovation intermediaries and emphasized on the fact that innovation intermediaries play a direct role in the scope of open innovation, by enabling different parties to transact and transfer knowledge (Chesbrough, 2006).

Nevertheless, this new concept goes beyond the open innovation approach as Living Labs give the opportunity to the different stakeholders to collaborate to develop a new product or service from the early stages of the innovation process until the product or service commercialization. Indeed, Bergvall-Kåreborn et al. (2009) bring to light several differences between Living Labs and open innovation. Firstly, they draw on the work of Eriksson et al. (2006) and Chesbrough and Appleyard (2007) and distinguish the fact that Living Labs focus on the creation of new products and services, while open innovation focuses on business models. Secondly, they draw on the work of Svensson and Ihlström Eriksson (2009) and Smith (2004) and show that Living Labs exploit external inputs throughout the whole process of innovation, from the ideation until the product commercialization, which is not the case in the classical approach of open innovation, where the external input mainly focuses on ideas and technology (Bergvall-Kåreborn et al., 2009). The Table 2 summarizes our reflection on Living Labs in the open innovation landscape.

Table 2 - Elements of the Living Lab in and out of the scope of open innovation

Elements of the Living Lab in the scope of open innovation	**Elements of the Living Lab out of the scope of open innovation**
• Exchanges of knowledge between several actors outside the boundaries of the firm • Status of innovation intermediary • Focus on value creation for all actors	• Contribution of external stakeholders used throughout the whole innovation process • Collaboration of stakeholders in around a common objective of product/service creation

Now that we have gathered some insights on the link between Living Labs and open innovation, we will explore the presence of user innovation in Living Labs settings. When the conceptualization of 'Living Lab' first emerged, it has been described as "a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts" (Mitchell as cited in Eriksson et al, 2005, p.4). However, even though this first definition highlights a user-centered approach to innovation, the literature has been more and more considering the Living Lab as a way to involve users actively in the innovation process. Indeed, Schaffers et al. (2007) consider the users as a valuable source of innovation in Living Labs, and not simply as object for testing and feedback. According to the authors, Living Labs draw on the concept of 'democratic innovation',

introduced by von Hippel in 2005, by encouraging the active participation of users and user communities in the innovation process (Schaffers et al., 2007). Levén and Holmström (2008) add that the involvement of users is much more than an access to information, but it is rather related to the design, development and validation of new products and services (Levén & Holmström, 2008). The user is considered as 'an expert of his own experience' and as a real partner in the innovation process, collaborating with designers and researchers (Almirall & Wareham, 2011). Living Labs thus go beyond user-centred approaches by involving users in an interactive and empowering way (Beutel, Jonas & Moeslein, 2017).

If we look back at the user innovation concept, the work von Hippel (1976, 1977, 1988, 2002, 2005, 2007) often emphasized on the valuable input of users in terms of needs, and especially in terms of product concept and design. As the source of innovation is centered on the user, the innovation motives are mainly driven by the utility gains for the users (von Hippel, 1977b; Morrison, Roberts & von Hippel, 2000), and not especially pecuniary advantages (Bogers & West, 2012). In Living Labs, the same logic applies. As users have an active role in the product concept and design, we understand from the hypothesis made by von Hippel (1977b) and confirmed by Morrison, Roberts and von Hippel (2000), that those users expect to benefit from this innovation, and therefore expect significant utility gains. We thus deduce from the characteristic of active user involvement that the innovation is at least partly focused on utility gains for the users, which is in line with the user innovation approach.

Nevertheless, the Living Lab approach goes beyond the boundaries of user innovation. Bergvall-Kåreborn et al. (2009) inform us about some discrepancies between the Living Lab approach and user innovation. Firstly, user innovation is considered as an approach exploring users' inputs on new product concepts and designs from inside the company, while the Living Labs projects do happen in a specific infrastructure outside the boundaries of the firm. Secondly, user innovation often covers parts of the innovation process, but the commercialization stage is generally performed by the manufacturer, while Living Labs support the whole innovation process with the collaboration of users (von Hippel, 1977b; Bergvall-Kåreborn et al., 2009). Moreover, we understand from the user innovation approach that innovation is a process taking place between the firm and the users, but as we argued previously, the Living Lab approach is an innovation process that do not only includes the firm and the users, but also many different stakeholders, such as academia, other companies,

government, technological centers, etc. (Almirall & Wareham, 2011). This last aspect distinguishes the Living Lab from the user innovation concept and brings it nearer to the open innovation concept. The Table 3 summarizes our reflection on Living Labs in the user innovation landscape.

Table 3 - Elements of the Living Lab in and out of the scope of user innovation

Elements of the Living Lab in the scope of user innovation	**Elements of the Living Lab out of the scope of user innovation**
• Active user involvement in the product and concept design • Focus on the utility gains for users	• Innovation process happening outside the boundaries of the firm • Involvement of users from the early stages of the innovation process until the commercialization • Involvement of additional participants in the innovation process

After having reviewed the similarities and differences between the Living Lab concept and the open innovation approach on the one hand, and the user innovation approach on the other hand, we will now look at the proposition of Schuurman, De Marez and Ballon (2013) to position the concept of co-creation, as well as the Living Lab approach, between the perspectives of open innovation and user innovation.

In order to better understand the potential existence of a link between co-creation and the two approaches of open and user innovation, it seems useful to firstly discover what underlies the term “co-creation”. Perks, Gruber and Edvardsson (2012) propose the following definition: “co-creation involves the joint creation of value by the firm and its network of various entities (such as customers, suppliers and distributors) termed here actors. Innovations are thus the outcomes of behaviors and interactions between individuals and organizations” (Perks, Gruber and Edvardsson, 2012, p. 935). Several insights can be retrieved from this definition. One important aspect is the value created through the collaboration of various stakeholders. We understand that the involvement of different stakeholders in the process of value creation can be seen as a form of open innovation, as open innovation is mainly based on knowledge exchange between internal and external actors. Frow et al. (2015) have the same opinion and state that they view co-creation as a particular form of open innovation. Nevertheless, they make the distinction with the opinion of Van Stiphout (2010)

and Barczak (2012), who position co-creation as a category within open innovation (Frow et al., 2015). In other words, co-creation is a concept that presents some similarities with open innovation, but it also presents differences. In order to spot those similarities and differences, we will explore the components of co-creation and we will make a comparison with the concept of open innovation, as well as with the concept of user innovation, given the fact that Schuurman, De Marez and Ballon (2013) proposed to position co-creation between open innovation and user innovation. The co-creation concept includes two major dimensions: (1) the co-production dimension, where customers take an active role in producing goods and services, and (2) the collaborative value-in-use activities, including the actors involved in the co-creation process, the value chain efficiency, and the network economies (Frow et al., 2015). The first dimension emphasizes on the relationship between the user and the firm, as well as the active role of users in the production of goods and services. We easily understand from our previous argumentation that this is a characteristic of the user innovation approach, but not really one of the open innovation approach. The second dimension emphasizes on four different elements. The actors in the co-creation process represent a wider range of stakeholders than the usual dual interaction between the firm and the users, or between the firm and other firms (Frow et al., 2015). The participation of multiple stakeholders represents a characteristic of the open innovation approach, but not one of the user innovation approach. Within the second dimension, the value chain efficiency represents the range of opportunities available to create value through co-creation; this includes the product or service conception, design, production, promotion, pricing, distribution, consumption, maintenance, disposal and outsourcing (Frow et al., 2015). This illustrates the possibility to use co-creation at each step of the product development, as well as after the commercialization. From our understanding of the two approaches, we assume that this is neither a characteristic of open innovation, nor one of user innovation. Finally, within the second dimension, network economies represent a dynamic process where the value is created through the relationship between the different actors (Frow et al., 2015). We also observe this characteristic in the definition of Perks, Gruber and Edvardsson (2012), stating that the “innovations are […] the outcomes of behaviors and interactions between individuals and organizations” (Perks, Gruber and Edvardsson, 2012, p. 935). In open innovation, the value come from the exploitation of external sources of knowledge, but there is no consideration of a dynamic process of collaboration. In user innovation, the values come from the product concept or design proposed by the user.

Therefore, we consider that this is an aspect outside of the scope of both approaches. As a matter of clarification, the main conclusions are summarized in the Table 4.

Table 4 - The dimensions underlying co-creation compared to the open innovation and user innovation approaches

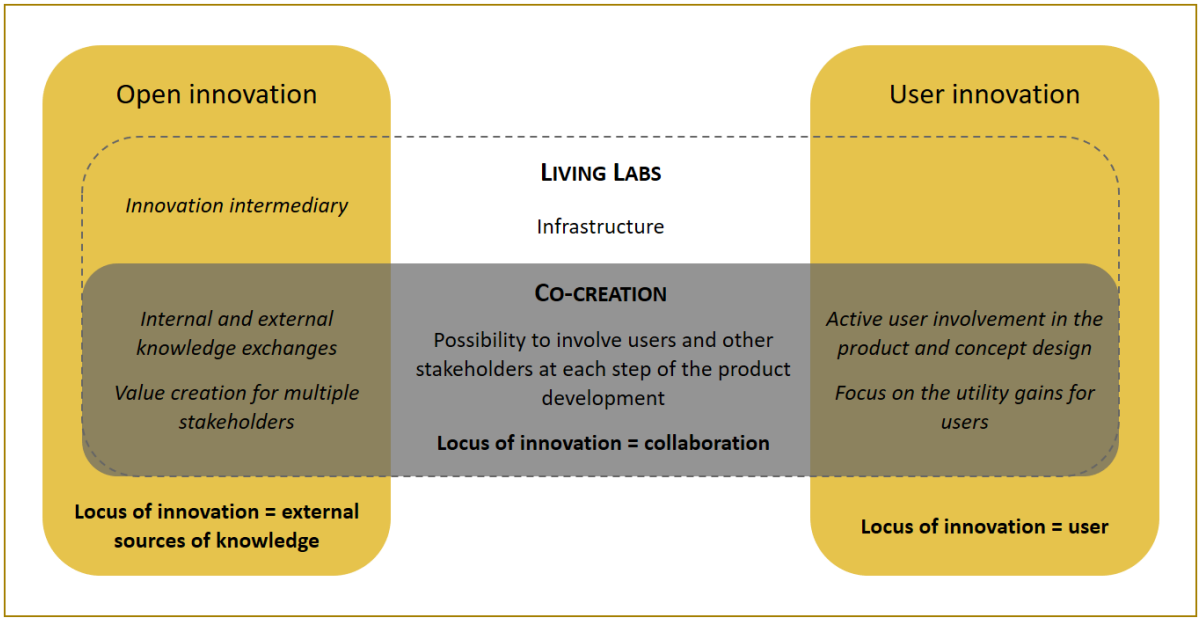
Co-creation	Open innovation	User innovation
Co-production		
• Active role of the user in the production of goods and services	☐	☒
Collaborative value-in-use activities		
• Participation of multiple stakeholders	☒	☐
• Value chain efficiency	☐	☐
• Network economies	☐	☐

When we look back at Living Lab's elements that are out of the scope of the open innovation and user innovation concepts, and compare them with the different dimensions underlying the co-creation concept, we see that the conclusions merge and we can quickly figure out that Living Labs are related to co-creation. Feurstein and al. (2008) and Schumacher and Feurstein (2007) agree on this point and mention the importance of the co-creation process towards the creation of new products or services in Living Labs. Westerlund and Leminen (2011) also confirm this link and argue that users as well as other participants in Living Labs become real co-creators of value by participating in the innovation process (Westerlund & Leminen, 2011). On the one hand, the value for the user lies in the expected utility gains resulting from the co-creation process, while the value for the firm is in the external knowledge they gather via the co-creation process (Beutel, Jonas & Moeslein, 2017). Therefore, the locus of value creation and innovation changes compared to the open innovation and user innovation approaches. As we said earlier, the locus of innovation is the external sources of knowledge in open innovation, while the locus of innovation is the user in user innovation. With the concept of co-creation, the locus of innovation is not fixed anymore, but rather dynamic and lies within the collaborative interactions between the different stakeholders. This is also the case in Living Labs, where the role of Living Labs is to orchestrate the interaction between the different stakeholders and facilitate the co-creation process (Beutel, Jonas & Moeslein, 2017). Levén and Holmström (2008) add that there exists a process

management actor in Living Labs who designs activities and offers services in order to make the engagement in the system worthwhile to each stakeholder in order to keep the innovation system together (Levén & Holmström, 2008). We can therefore conclude that Living Labs are characterized by co-creation and we thus decide to follow the proposition of Schuurman, De Marez and Ballon (2013) to position the concept of co-creation, as well as the Living Lab approach, between the perspectives of open innovation and user innovation.

Nevertheless, we decide to go further and consider Living Labs as systems using a co-creation process, but going beyond this process by leaving the boundaries of the firm and providing an independent infrastructure that promotes the interactions between the different stakeholders and facilitates the co-creation process. Beutel, Jonas and Moeslein (2017) give us insights about the Living Lab's infrastructure, stating that Living Labs provide novel structures for user involvement and opportunities of experimentation in real-life settings. This leads us to consider the Living Lab as a materialization of a co-creation process between multiple stakeholders, building a new place for collaboration, compared to the simple co-creation methodology that is traditionally used by firms with their users. The authors add that the role of the Living Lab as an innovation intermediary moves the firm-user interaction towards an intermediary-user interaction, and the Living Lab can thus be seen as a co-creation agent for the firm. The structure permits users to be involved in an interactive and empowering way, and the real-life settings overcome the hurdles in knowledge transmission relating to sticky information and tacit knowledge (Beutel, Jonas & Moeslein, 2017). We will develop further the Living Labs' characteristics in the next part. The Figure 1 on the next page summarizes our main conclusions and shows the boundaries between the concepts of open innovation, user innovation, co-creation and Living Labs.

Figure 1 **Living Labs as a bridge between open innovation and user innovation**



4. Conclusion

In this chapter, we started by exploring the main factors that led to a shift from the vertically integrated innovation model toward the distributed innovation model, conceptualized by von Hippel in 1988. Those factors included, among others, the increasing availability and mobility of skilled workers, the expansion of venture capital since 1980, and the shortening of product life cycles (Chesbrough, 2003a; 2003b). In the scope of the distributed innovation model, two main line of thought stand out: the open innovation phenomenon, proposed by Chesbrough (2003a; 2003b; 2006; 2007; 2012), and the user innovation processes, outlined in the work of von Hippel (1976, 1977, 1988, 2002, 2005, 2007). In the scope of open innovation, internal and external sources of knowledge can be exploited into revenue-generating practices and firms can capture a greater value by making use of the key resources and competences of other firms' businesses (Chesbrough, 2003a; 2006; Bogers & West, 2012). They can do so in three main ways; by funding innovation, by generating innovation, and by commercializing innovation (Chesbrough, 2003b). In the scope of user innovation, the role of the user is not restricted to communicate their needs anymore; but rather to participate in the conception and design of new innovative solutions (von Hippel, 1977b). It has however been observed that the role of user in the innovation process varies significantly among industries (von Hippel, 1977a; 1977b; 1988). One of von Hippel's most agreed upon hypothesis explaining this difference amongst industries is the fact that users

expect to benefit more from the innovation outcome than manufacturers in some industries, referred as user-dominated industries (von Hippel, 1977b). Hence, von Hippel (1977b) recommends firms to organize their innovation effort differently by switching from manufacturer-sourced to user-sources innovation activities. Also, in order to react to the difficulties encountered by market researchers in identifying valuable sources of information in fast-moving industries, von Hippel introduces the concept of "lead users", who represent users facing needs that will be general in a marketplace months or years later, and who would benefit significantly from obtaining a solution to those needs (von Hippel, 1986; 1988). In the user innovation landscape, the locus of innovation is therefore the users and the value lies in the utility gains for the users (Bogers and West, 2012). Many methods have been evolving under the umbrella of user innovation, and a categorization has been proposed by Almirall, Lee and Wareham (2012) going from a passive role of users in the user-centered innovations, including the examples of applied ethnography and testbeds, until user-driven innovations where the user controls the innovation process, such is the case in the lead user method proposed by von Hippel (1986), and in Fab Labs. Two other categories are in between; the design-driven innovations where the subjective meanings that people give to products is emphasized, and the participatory design attempting to actively involve multiple actors in the innovation process, such is the case in Scandinavian innovation methods.

After having reviewed the two broad concepts of open innovation and user innovation, we identified the main convergences and divergences between those two approaches, and the concepts of Living Labs and co-creation. We concluded that there is a strong link between co-creation and Living Labs, where the locus of innovation lies in the collaboration between multiple stakeholders. We also decided to follow the proposition of Schuurman, De Marez and Ballon (2013) to position the concept of co-creation, as well as the Living Lab approach, between the perspectives of open innovation and user innovation. Our main findings are that the Living Lab retrieves the ideas of internal and external knowledge exchanges, innovation intermediary and value creation for multiple stakeholders from the open innovation stream; and the ideas of active user involvement in the product and concept design and focus on the utility gains for users from the user innovation stream. Living Labs thus distinguish themselves from those two approaches in the fact that they collaborate with users and other stakeholders along the whole innovation process, and they orchestrate the stakeholders' relationships and interactions in a specific infrastructure facilitating the co-creation process.

In the next chapter, we will explore the opinion of ENoLL concerning the roots of the Living Lab concept from an historical perspective.

Chapter 2 – EnoLL contribution in the Living Lab history

In this chapter, we focus mainly on the opinion of ENoLL regarding the origination of the Living Lab concept from an historic point of view. We will also gather briefly some insights from the work of Dubé et al. (2014). On the contrary with the previous section which aimed at investigating the distributed innovation methods influencing the rise of Living Labs, this chapter proposes a short historical background eventually leading to the birth of Living Labs.

1. The three main predecessors of Living Labs

According to ENoLL (2016), three main predecessors carry the roots of the current Living Labs movement when looking back through the European history of ICT innovation and user involvement: (1) the Scandinavian cooperative and participatory design movement from the 1960s and 70s, (2) the European social experiments with IT in the 1980s, and (3) the Digital City projects from the 1990s.

First, the cooperative and participatory design methods arose back in the 1960s and 70s in Scandinavia when research projects started to involve the users' participation in the development processes. At the beginning, such users' involvement was supported by trade unions in the workplace and involved the workers in IT applications and the design associated. Progressively, the cooperative design has been starting to include new ways to facilitate trial processes by analyzing the responses of users who tested the future applications in a real-life context. Later on, IT broke through the walls of the workplace and invited itself inside home, inside schools and in many other environments. It resulted in the fact that cooperative design and thus much of the technological development no longer happened within isolated and well-defined communities at the workplace (ENoLL, 2016).

Second, in the 1980s, social experiments encouraged by the European Commission were used as a test and as an implementation methodology in the context of ICT ongoing development. Those social experiences "refer to experiments taking place outside of laboratories and therefore with less physical isolation of subjects and materials, less procedural standardization and longer-lasting treatments when compared to experiments in laboratory settings" (ENoLL, 2016, p.17). Hence, several programs have been launched by the

European Commission focusing on social innovation with for example experiments related to the implementation of telecentres in rural areas or the development of a broadband cable in several European countries. Those experiments were taking place in real-life environments and focused on developing social innovation based on ICT (ENoLL, 2016).

Third, the digital city concept arose during the 1990s and spread out in Europe and beyond. According to ENoLL (2016), this concept refers to "a number of digital initiatives undertaken by cities, especially related to digital representations of the city, digitally related economic development and urban regeneration initiatives and the provision of Internet access for citizens" (ENoLL, 2016, p.17). The concept was considered mainly as technology-driven and less participative/design-driven. In that view, it is noticeable that existing Smart City initiatives present tight links with diverse Living Labs organizations. Indeed, apart from large-scale technological infrastructure, participative and design approaches are well present in the original concept of digital city. The digital city initiatives are per se multi-stakeholders due to the fact that connections take place between various actors on a large scale. Moreover, links with user involvement exist with the users really considered as potential innovative agents and technical infrastructure used as a trigger for creativity (ENoLL, 2016).

ENoLL considers the emergence of the Living Lab concept as the natural continuation following the three approaches cited above.

2. The emergence of the Living Lab concept

Although the term "Living Lab" has been used in the literature to denominate diverse innovation initiatives, the birth of this concept has been attributed to William (Bill) Mitchell, professor at the Massachusetts Institute of Technology (M.I.T.), who was regarded as one of the major thinker on Smart Cities. According to ENoLL (2016), William Mitchell used this term in the first years of the 2000s to describe laboratories where volunteer participants could live in a temporary home, so that daily life could be observed and experimentally manipulated. The first objective of Living Labs was therefore to test and adapt cutting-edge technologies to daily domestic environments by using a wide range of tools to track the users' habits and routines. Those living laboratories reinterpreted the former US home labs by involving users in their daily life instead of observing them in a recreated natural context within a laboratory milieu (ENoLL, 2016). In 2005, the Living Lab model started to go beyond the M.I.T. and accommodated to the European context. After several small-scale investments and pilot

projects, the European program supporting innovation through Living Labs launched in 2006 led to the creation of the European Network of Living Labs (Dubé et al., 2014). This network firstly took shape through an agreement between several cities that were involved in the Intelligent Cities (Intelcities) project and this led up to the first wave of the European Network of Living Labs (ENoLL, 2016). The objective of this agreement was to structure the emergence of Living Labs and exchange best practices. Even if the name itself refers to a European network, ENoLL has a worldwide reach. Indeed, its community embraces Living Labs from all over the world in a global network of open innovation ecosystems. Incorporation of new members within the network is done by a system of annual waves (ENoLL, 2016) (see Appendix 2).

3. Conclusion

In this chapter, ENoLL's opinion on the historical roots of Living Labs brings the light on the real-life characteristic of Living Labs, present in both the Scandinavian methods and the social experiments of the 1980s. It also confirms the multi-stakeholder aspects of Living Labs, derived from the social experiments of the 1980s and the digital cities in the 1990s. We understand from the historical approach of ENoLL that several approaches already include several characteristics of the Living Lab approach, but none of them includes them all and they can thus be considered as carrying the roots of the Living Lab concept. Nevertheless, we decide to keep some distance from this affirmation as ENoLL does not constitute a scientific source in the innovation literature. In order to get a deeper view on the Living Lab's characteristics, we will explore the different definitions of the Living Lab from the literature in the next part in order to retrieve the main characteristics of Living Labs.

Part 2 – Defining the Living Lab concept

After having explored the literature that permitted to create a link between Living Labs, co-creation and the two approaches of open innovation and user innovation, we have discovered some additional insights on the Living Lab's characteristics through the historical approach of ENoLL. Nevertheless, some pieces are still missing. In this part, the objective is to understand what is a Living Lab and what is not a Living Lab. For that purpose, we will start by exploring the different definitions of Living Labs in the literature in order to stick to a clear list of features characterizing the Living Lab approach. We will also look at the divergences between the definitions and make a stand regarding those differences. Those convergences and divergences will therefore clarify what is a Living Lab and will help us build our own definition. Nonetheless, in order to fully understand what is not a Living Lab and what distinguishes the Living Lab from other approaches, we will compare it to three innovation concepts that have been defined in the scope of user innovation; namely the Fab Lab, the testbed and the lead user method. In that view, this part is divided into three chapters. The first one will look at the different definitions from the literature and bring to light the convergences and divergences, the second one will gather the insights from the first chapter to propose a new definition, and the third one will compare the four following approaches: Living Lab, Fab Lab, testbed, and lead user method.

Chapter 1 – The different visions of the Living Lab in the literature

In this chapter, the first step will be to look at the practitioners' opinion on this lack of common and shared definition of the Living Lab concept. Then, we will explore the convergences and the divergences amongst the definitions proposed by different authors in the literature in order to get some insights to create our own definition.

1. Lack of a common and shared definition

When talking about the concept of Living Labs, the first difficulty encountered is the definition of this particular concept. Indeed, "there is no clear definition of Living Labs since different competing approaches exist" (Almirall & Wareham, 2008, p.26). Many authors and practitioners have suggested a definition of the Living Lab concept but a common and shared definition has not yet been established. Dell'Era and Landoni (2014) add that this lack of a widely-recognized definition regarding the Living Labs phenomenon is related to the limited

attention towards this concept in the literature. According to the authors, despite their diffusion throughout Europe and recent interest from policy makers, the newness of the phenomenon and the high heterogeneity of cases results in a lack of definitions and acknowledged frameworks for scholarly analyses (Dell'Era & Landoni, 2014).

In terms of the utilization of the word "Living Labs", Veeckman et al. (2013) argue that the wide variety of projects carried out under the Living Lab umbrella has raised the emergence of a "catchall term" (Veeckman et al., 2013). Leminen (2015) emphasizes on this idea by stating that the term "Living Lab" is at risk of becoming a buzzword in the innovation domain (Leminen, 2015). Indeed, this concept has been discussed from heterogeneous perspectives in the literature, from business economics to innovation management, through policy and sociology, which resulted in a plurality of meaning given to the same concept (Veeckman et al., 2013). Thus, given the fact that this concept can cover a wide range of approaches, it is complex to agree on a unique definition of Living Labs (Seys et al., 2013). As a consequence, a plethora of definitions have been developed, each of them trying to define this particular concept of "Living Labs" as best as possible.

2. Exploration of the convergences amongst the Living Lab's definitions

Confronted to a plethora of definitions, our methodology to refine the Living Lab concept was the following. Firstly, we decided to read and gather, without filter, definitions from the scientific literature but also from institutions. In this scope, several authors and Living Labs practitioners were investigated, including Almirall et al., 2012; Arnkil et al., 2010; Ballon et al., 2007; Bergvall-Kåreborn et al., 2009; Dell'Era & Landoni, 2014; ENoLL, 2016; Eriksson et al., 2005; Ferrari et al., 2011; Feurstein et al., 2008; Lehmann et al., 2015; Leminen et al., 2012; Leminen & Westerlund, 2012; Leminen et al., 2014; Lepik & Varblane, 2010; Lievens et al., 2011; Mitchell as cited in Eriksson et al., 2005; Mulder & Stapper, 2009; Niitamo et al., 2006; Oliveira et al., 2006 ; Pallot, 2006; Pallot et al., 2010; Schaffers & Kulkki, 2007; Schaffers et al., 2012; Schumacher & Niitamo, 2008; Schuurman et al., 2012; Schuurman et al., 2013; Seys et al., 2013; and Westerlund & Leminen, 2011. Secondly, we selected some definitions highlighting, according to us, valuable insights on Living Labs distinctive characteristics. Thirdly, we retrieved the components of the definitions selected in order to identify the Living Lab's key characteristics. The definitions selected in our analysis process are cited in the Table

5, as well as the relevant characteristics retrieved from those definitions. It is important to outline that this list of proposed definitions is non-exhaustive.

Table 5 – Set of selected definitions from the Living Lab literature and identification of the main characteristics

Definitions	Characteristics highlighted
"The Living Lab concept is a research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts" (Mitchell as cited in Eriksson et al, 2005, p.4)	• Multiple and evolving real life contexts
"Living Lab is an emerging public–private partnership (PPP) concept in which firms, public authorities and citizens work together to create, prototype, validate and test new services, businesses, markets and technologies in real-life contexts, such as cities, city regions, rural areas and collaborative virtual networks. Living Labs also depend upon a multi-methodological approach, with different research methods aimed at accessing the ideas and knowledge of these users" (Niitamo et al., 2006, p.1).	• Public-private partnership • Creation of new services, businesses, markets and technologies • Real-life contexts • Multi-methodological approach
"Innovation platform that […] engage all stakeholders such as end-users, researchers, industrialists, policy makers, and so on at the earlier stage of the innovation process in order to experiment breakthrough concepts and potential value for both the society (citizens) and users that will lead to breakthrough innovations" (Pallot, 2006, p.4).	• Engagement of multiple stakeholders • Users lead the innovation
"Experimentation environment in which technology is given shape in real-life contexts and in which (end) users are considered 'coproducers'" (Ballon et al., 2007, p.156).	• Real-life contexts • Users are co-producers
"Living Labs 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" (Feurstein et al., 2008, p.2).	• Public-private-civic partnerships • Stakeholders co-creation • New product, services, businesses and technologies • Real-life environments

	• Multi-contextual sphere
"Living Labs are physical regions or virtual realities in which stakeholders form public-private-people partnerships (4Ps) of firms, public agencies, universities, institutes and users all collaborating for creation, prototyping, validating and testing of new technologies, services, products and systems in real-life contexts" (Westerlund & Leminen, 2011, p.20).	• 4Ps • Collaboration for creation • New technologies, services, products and systems • Real-life contexts
"The concept of Living Labs as a research approach where users are considered as co-partners in the process of innovation and where they can materialize their own needs, aspirations and wishes in their real-life context through active involvement" (Seys et al., 2013, p.4).	• Users as co-partners • Real-life context • Active involvement
"A Living Lab is a design research methodology aimed at co-creating innovation through the involvement of aware users in a real-life setting" (Dell'Era & Landoni, 2014, p.139).	• Co-creation • Users involvement • Real-life settings
"Living Labs are defined as user-centred, open innovation ecosystems based on a systematic user co-creation approach integrating research and innovation processes in real life communities and settings following a multi-methods approach" (ENoLL, 2016, p.12).	• User co-creation • Real-life settings • Multi-methods approach

The first observation that we can make from the Table 5 is that the highlighted characteristics often converge. Therefore, in order to clarify the main characteristics, we decided to gather them into five distinctive groups. The first group brings together the following insights from the definitions above: "users lead the innovation" (Pallot, 2006), "users as co-producers" (Ballon et al., 2007), "stakeholders co-creation" (Feurstein et al., 2008), "users as co-partners" (Seys et al., 2013), "active involvement" (Seys et al., 2013), "co-creation" (Dell'Era & Landoni, 2014), "users involvement" (Dell'Era & Landoni, 2014), and "user co-creation" (ENoLL, 2016). This first group will be referred as "active and co-creative users". The second group brings together the following insights: "multiple and evolving real life contexts" (Mitchell as cited in Eriksson et al., 2005), "real-life contexts" (Niitamo et al.,

2006; Ballon et al., 2007; Westerlund & Leminen, 2011, Seys et al., 2013), “real-life environments” (Feurstein et al., 2008), “multi-contextual sphere” (Feurstein et al., 2008), and “real-life settings” (Dell’Era & Landoni, 2014; ENoLL, 2016). This second group will be referred as “real-life settings and multi-contextual sphere”. In the third group, we summarize the following components: “public-private partnership” (Niitamo et al., 2006), “engagement of multiple stakeholders” (Pallot, 2006), “collaboration for creation” (Westerlund & Leminen, 2011), and “public-private-people partnerships” (Feurstein et al., 2008; Westerlund & Leminen, 2011). This third group will be referred as “collaboration amongst multiple stakeholders”. Fourth, the characteristics: “multi-methodological approach” (Niitamo et al., 2006), and “multi-methods approach” (ENoLL, 2016) are gathered and will be referred as (4) multi-methods approach. Fifth, the characteristics: “new services, businesses, markets and technologies” (Niitamo et al., 2006), “new product, services, businesses and technologies” (Feurstein et al., 2008), and “new technologies, services, products and systems” (Westerlund & Leminen, 2011) are gathered and will be referred as (5) new product or service development.

After having read numerous definitions, selected the most relevant and highlighted the main characteristics, we decided to choose the following five characteristics as the key elements underlying the Living Lab concept: (1) active and co-creative users, (2) real-life settings and multi-contextual sphere, (3) collaboration amongst multiple stakeholders, (4) multi-methods approach, and (5) new product or service development. Those five characteristics will be developed hereafter based on the literature.

2.1. Active and co-creative users

The first element representing an essential characteristic of Living Labs is the high level of user involvement. Indeed, this active involvement of users in the innovation process is highly emphasized in the literature (Pallot, 2006; Ballon et al., 2007; Dell’Era & Landoni, 2014; ENoLL, 2016; Feurstein et al., 2008; Schumacher & Feurstein, 2007; Schuurman et al, 2013; Seys et al., 2013). As a matter of fact, users are considered as active players, co-researchers, co-partners, co-producers and co-creators in the process of innovation where they can materialize their own needs, aspirations and wishes through active involvement (Seys et al., 2013). The importance of active user involvement is also reflected in the fact that users are engaged at all stages of the innovation process, including design, prototyping, development

and implementation (Dubé et al., 2014). Hence, a constant loop is implemented to include the users' feedback at each stage in order to continuously refine the innovation (Seys, 2013). In that view, users are aware of the innovation process and decide to actively contribute to the innovation outcome. Hence, users are on equal ground with the rest of the stakeholders and are therefore considered as an equal collaborator participating in the same way as the other contributors to the project (Schuurman et al, 2013; Seys et al., 2013). Feurstein et al. (2008) add that "the Living Lab provides a bilateral access; the customers can access freely the new and emerging products during the development phase, while the developing company have access to the customers' feedback" (Feurstein et al., 2008, p.2). Therefore, we can deduce that this form of user involvement meets the characteristics of the participatory design methods; namely the equal ground between users and the other stakeholders, the active user involvement through co-creation, and the awareness of users in the innovation process.

Moreover, this high intensity of user involvement has also been inspired by user-driven innovation methods, such as the lead user method. In the literature, several authors emphasize on the fact that users drive the innovation outcome in Living Labs (Leminen et al., 2014; Pallot et al., 2010; Seys et al., 2013). Here, we highlight the fact that users are considered as "experts" and lead to breakthrough innovations (Pallot et al., 2010). However, Living Labs differ from the lead user initiatives in the sense that they do not only consider expert users, but they include a wide range of users having different roles in the innovation process. Leminen, Westerlund, and Nystöm (2014) identified four user roles in Living Labs: (1) informant, (2) tester, (3) contributor, and (4) co-creator. Depending on the degree of user activity and their expertise, users will be integrated differently within the innovation process (Leminen, Westerlund, & Nystöm, 2014). Thus, some users are considered as "lead users", while some users are not considered as experts in the domain. In that sense, we can deduce that the lead user method is one of the roots of the Living Lab concept, and that a mix of different users having specific roles makes one of the characteristics of Living Labs.

As a conclusion, Living Labs present a high level of user involvement, which can be divided into two forms. First, active user involvement through co-creation inspired from participatory design methods. Second, involvement of a mix of expert and non-expert users inspired from user-driven innovation methods.

2.2. Real-life settings and multi-contextual sphere

The second element that the literature agrees on is the real-life context. Various authors in the literature argue that Living Labs allow for creating, testing and validating innovations in real-life environments, such as cities, city regions, rural areas and collaborative virtual networks between public and private players (Ballon et al., 2007; Bergvall-Kåreborn et al., 2009; Dell'Era & Landoni, 2014; ENoLL, 2016; Eriksson et al., 2005; Feurstein et al., 2008; Lacasa et al., 2007; Schumacher & Feurstein, 2007; Schuurman et al., 2013). According to Schuurman et al. (2013), a real-life context implies the embedment of users in a familiar context that reflects their natural everyday environment. In that view, Living Labs do not recreate a familiar context in a laboratory setting, but test and validate prototypes outside laboratories. This real-life context, whether real or virtual, permits the observation of uncontrollable dynamics of everyday life, which enable an extensive understanding of the innovation's usage (Schuurman et al., 2013). As the product or service is made available to users to experience it in their everyday life, this permits the identification of problems that could not be reproduced in a controlled and closed laboratory environment; everyday life being an open system to the world where a variety of influences, constraints and opportunities can be manifested. We can therefore deduce that this characteristic of Living Labs is closely related to the Scandinavian methods of innovation in the scope of the participatory design, as well as the European social experiments with IT in the 1980s, which both emphasized on the importance of testing products and services in real-life settings.

Several authors also mention that Living Labs can take place in multiple and evolving real-life contexts (Eriksson et al., 2005; Feurstein et al., 2008; Mitchell as cited in Eriksson et al., 2005; Schumacher & Feurstein, 2007). Those multiple and evolving contexts are referred as the "multi-contextual sphere". In that sense, Living Labs are seen as a way to validate a product or service to fit the needs of different populations with different life styles, as they give the opportunity to test and validate new products or services across regions and across diverse socio-cultural environments (Feurstein et al., 2008).

2.3. Collaboration amongst multiple stakeholders

The third characteristic of Living Labs is the multi-stakeholder aspect. Here, the literature shows that interaction and collaboration between multiple stakeholders in Living Labs is an essential aspect in order to promote knowledge sharing and to reinforce the

authenticity of real-life contexts (Bergvall-Kåreborn et al., 2009; Dubé et al., 2014, ENoLL, 2016; Eriksson, Niitamo & Kulkki, 2005; Feurstein et al., 2008; Lacasa et al., 2007; Pallot, Trousse, Senach, & Scapin, 2010; Schumacher & Feurstein, 2007; Seys et al., 2013; Westerlund & Leminen, 2011). From the literature, we identified six main categories of stakeholders that are part of the private, public and people environment: (1) users, (2) companies, (3) researchers and developers, (4) public agencies, (5) universities and specialists, and (6) investors. Those categories are described in the Appendix 3.

By engaging different stakeholders as of the early stage of the innovation process, breakthrough innovation can be achieved as long as this collaboration brings value for the different groups of stakeholders involved (Eriksson, Niitamo & Kulkki, 2005). Those collaborations between the citizens and the private and public sphere are often described as public-private-civic partnerships or public-private-people partnerships (Feurstein et al., 2008; Schumacher & Feurstein, 2007; Westerlund & Leminen, 2011; Lapointe & Guimont, 2015). Lapointe and Guimont (2015) describe this type of partnership as a "strategic dialogue space between businesses, public services, universities and users to co-create innovative solutions to real and complex problems" (Lapointe & Guimont, 2015, p.69). As we observed in the previous chapter, this multi-stakeholders aspect is also present in the European social experiments with IT in the 1980s as well as Digital and Smart cities' initiatives. Indeed, these two approaches also involve different stakeholders in the innovation process.

2.4. Multi-methods approach

The fourth aspect that characterizes Living Labs is the multi-methodological approach. In the literature, Living Labs aim to combine different instruments, methodologies, tools and research avenues in order to access the ideas and knowledge of the users and stakeholders (Eriksson et al., 2005; Feurstein et al., 2008; Leminen, 2015; Leminen & Westerlund, 2016; Mastelic et al., 2015; Mulder, 2012; Nyström et al., 2012; Pallot et al., 2010; Veeckman et al., 2013). The various innovation methods used in Living Labs come from different schools of thoughts, such as user-centered methods, participatory design methods, and user-driven methods. A we understand from the literature; different methods are used at each step of the innovation process in order to discover new opportunities and mobilize the most appropriate co-creative and field experimentation methods in different contexts. Also, according to Leminen and Westerlund (2016), unexperienced Living Labs tend to develop their own

methods and tools through customization, while more experienced Living Labs tend to pursue standardization of the usage methods (Leminen & Westerlund, 2016). We observe that this plurality of methods used is also a feature present in the European social experiments realized in the 80s. Indeed, those experiments used to combine different methods and tools coming from a wide range of disciplines, such as psychology, sociology, engineering or ethnography (ENoLL, 2016).

2.5. New product or service development

Although this aspect is not always mentioned in the definitions developed in the literature, the creation of new products, services, businesses and technologies seems an essential characteristic of Living Labs. Dell'Era and Landoni (2014) agree on this point and state that "the definitions have failed to highlight the original new product development approach implied by the Living Lab methodology" (Dell'Era & Landoni, 2014, p.139). Even though various experiences co-exist in Living Labs, they all converge on the idea of proposing a new way to manage the new product or service development process (Dell'Era & Landoni, 2014). Several authors amongst others, such as Feurstein and al. (2008) or Schumacher and Niitamo (2008), agree on this point and mention the importance of the co-creation process towards the creation of new products or services, or towards the adaptation of existing products to the needs of the market. As one of the main goals of Living Labs when involving users in the innovation process is to provide them with a product or service that answers their needs, we believe that it is important to include that aspect in the categorization of Living Labs.

2.6. Clarification of the Living Lab concept based on the characteristics

Even though a common definition of the Living Lab concept is not present in the literature, a set of shared characteristics can be identified. Indeed, through the selected definitions, we identify five key features related to Living Labs: (1) active and co-creative users, (2) real-life settings and multi-contextual sphere, (3) collaboration amongst multiple stakeholders, (4) multi-methods approach, and (5) new product or service development. As we tried to clarify the Living Lab concept by searching at the shared characteristics, we also noticed that contradictions come forth concerning the nature of Living Labs.

3. Exploration of the divergences amongst the Living Lab's definitions

When we take a look at the various definitions proposed in the literature, we observe that there is a myriad of propositions as regard to the nature of Living Labs. We identified 10

different terms that were used in the literature in order to explain the nature of the Living Lab concept: (1) a milieu, (2) an environment, (3) a methodology, (4) an approach, (5) an intermediary, (6) a network, (7) a system, (8) a partnership, (9) an ecosystem, and (10) a platform. As a matter of clarification, we defined all those terms in the Appendix 4 and referred to the authors who used them to describe the Living Lab concept (Almirall et al., 2012; Arnkil et al., 2010; Ballon et al., 2007; Bergvall-Kåreborn et al., 2009; Dell'Era & Landoni, 2014 ; ENoLL, 2016; Eriksson et al., 2005; Ferrari et al., 2011; Feurstein et al., 2008; Lehmann et al., 2015; Leminen & Westerlund, 2012; Leminen et al., 2012; Leminen et al., 2014 ; Lepik & Varblane, 2010; Lievens et al., 2011; Mulder & Stapper, 2009; Niitamo et al., 2006; Oliveira et al., 2006; Pallot et al., 2010; Schaffers & Kulkki, 2007; Schaffers et al., 2012; Schuurman et al., 2012; Schuurman et al., 2013; Seys et al., 2013; Westerlund & Leminen, 2011). From the Appendix 4, we observed that some authors use different terms in their works, which illustrates the difficulty to stick to one clear definition. We also noticed that some terms used to describe the nature of Living Labs can be really broad, such as the terms "milieu" or "environment", while others are more specific, such as the terms "methodology or "intermediary". Nonetheless, all those concepts are somehow connected to each other and could describe the Living Lab concept given the fact that there is a wide variety of Living Lab's projects and initiatives.

According to our understanding of the concept, we will now argue why we rejected some of the terms proposed in the definitions coming from the literature. Firstly, we decided not to take into consideration the first two terms "milieu" and "environment" considering the scope of their definition. According to us, those terms are not appropriate to define the Living Lab concept given their broadness. Secondly, we decided to reject the term "methodology" or any other synonym, such as "tool", "method" or "technique". If we consider the high level of user involvement and the participation of multiple stakeholders in Living Labs, this human aspect is not taken into account in the term "methodology" as it has been defined as "a system of broad principles or rules" (Business Dictionary, 2017). Therefore, Living Labs are not driven by rules, but by the users and the stakeholders. Then, we will argue why we do reject the term "approach" as well. As we took a step back to identify the origins of Living Labs, we discovered that the Living Lab concept had been inspired by two main approaches, namely open innovation and user innovation. However, we do not consider the Living Lab as another approach, given the fact that one of the main characteristics of the Living Labs is the creation

of products, services or technologies. When looking at the term “intermediary”, we could imagine that Living Labs are considered as mediators between the different parties and facilitate the collaboration between the users, the private and the public spheres. This is also an aspect that had been highlighted in the first part, when we considered Living Labs as an open innovation intermediary. Nevertheless, the Living Lab concept does not just form a bridge between the different stakeholders, but they build a whole infrastructure in order to foster innovation and build a community of users in order to encourage a long-term relationship among members (Beutel, Jonas & Moeslein, 2017). We thus estimate that the Living Lab concept goes beyond the term “intermediary”, which is why we decide to reject this term for our definition. In the term “network”, we observe that the human aspect is present via a collaboration between actors (cf. Appendix 4). This goes along with the idea lying behind Living Labs but we do not consider this term as the most appropriate of the list given its emphasize on collaboration over long distance (cf. Appendix 4). Indeed, as the interaction, the collaboration and the co-creation are emphasized in real-life environments, the Living Lab concept relies on real interaction. The next term that has been used in the literature to describe the Living Lab concept is the “platform”. According to the definition in the Appendix 4, we observe that the value derived from a platform is created by the exchanges between several groups of people. Therefore, the focus is on transactions and exchanges between several groups, and not on co-creation. Therefore, we consider that people belonging to a platform do not collaborate to create something together, but they transact with one another in order to obtain something they are interested into. We therefore consider that this term is not the most suitable to define the Living Lab concept. In the definition of “system” (cf. Appendix 4), we discover some points that catch up with the Living Labs’ characteristics. The first thing that is representative of Living Labs is the interrelation and interdependence of several members towards the achievement of a common goal. However, this term is not considered as the most appropriate given the fact that the “ecosystem” or “business ecosystem” approach matches up even more with the idea lying behind Living Labs. In the ecosystem approach, several organizations are involved in the creation of a product or service through competition and cooperation (cf. Appendix 4). Those organizations can be customers, competitors, government agencies, etc. As in the system approach, there is a relationship of interdependence between the members of the ecosystem and every member should be flexible and adapt to each other. We are witnessing here the creation of a real dynamic of

collaboration between stakeholders where their participation in the innovation process will be beneficial in terms of acquired knowledge, economic value and social benefits. Those stakeholders, as in a biological ecosystem, form a self-sustaining community in real-life environments. The last term used in the literature is the term “partnership”. In the definition from the Appendix 4, we would like to emphasize on the pool of money, skills and other resources that take place in a partnership, as well as on the conditions of benefits sharing defined in accordance with an agreement between the parties. This exactly illustrates the contribution of all stakeholders in the Living Lab in order to achieve a specific objective. As we mentioned earlier, this kind of partnership between the public, private and people spheres is often referred as a public-private-civic or public-private-people partnership.

After having reviewed the different terms lied out in the literature to describe the nature of Living Labs, we decided to select the terms “ecosystem” and “partnership” for the construction of our own Living Lab definition. According to us, those two terms include all the components and key ideas lying behind the Living Lab concept, namely the collaboration between the public, private and people spheres, the focus on a common goal, the real-life environments, the resources pooling, the interdependence and the benefits sharing between different stakeholders, but also the creation of a new product or service.

4. Conclusion

In this chapter, we were confronted to numerous definitions, each of them trying to define Living Labs as best as possible. In order to retrieve some insights from those definitions, we explored the main convergences and divergences amongst the plethora of definitions. The first conclusion is that numerous definitions highlight the same characteristics of Living Labs. Therefore, we decided to group the main ideas underlying the definitions into five main characteristics: active and co-creative users, real-life settings and multi-contextual sphere, collaboration amongst multiple stakeholders, multi-methods approach, and new product or service development. The second conclusion is that most of the definitions diverge when it comes to choose a term to define the nature of Living Labs. In that scope, we explored more in depth the meaning of those terms and selected both “ecosystem” and “private-public-people-partnership” as best describing the Living Lab concept. In the next chapter, we will use those insights in order to build our own definition of Living Labs.

Chapter 2 - Definition of the Living Lab concept

In this chapter, we will use the insights from the previous chapter regarding the nature and the characteristics of Living Labs in order to build our own definition. After that, we will briefly check if our definition is in line with the decision to position the Living Lab as a bridge between open innovation and user innovation.

Based on the selection of "ecosystem" and "private-public-people-partnership" as best options to describe the Living Lab's nature and based on the five key characteristics we highlighted (active and co-creative users, real-life settings and multi-contextual sphere, collaboration amongst multiple stakeholders, multi-methods approach, and new product or service development), we developed the following definition of Living Labs and we will refer to this one in the continuation of this thesis:

"A Living Lab is an open innovation ecosystem taking place through a public-private-people partnership that aims to develop new products, services, businesses or technologies through active user involvement and co-creation as of the early stages of the innovation process by using multiple innovative methodologies to create, test and validate innovations in real-life settings within multiple and evolving environments".

The proposed definition might not be perfectly correct from an academic point of view, neither absolutely wrong, but reflects our understanding of the Living Labs concept. Also, this definition includes several components of the open innovation and user innovation approaches explored in the previous part. On the one hand, the exploitation of several external sources of knowledge coming from the open innovation stream is implied in the partnership between the private, the public and the people spheres. On the other hand, the involvement of users in the development of innovations coming from the user innovation stream is also present in our proposed definition. This definition is thus in line with our decision to place the Living Lab as a bridge between open innovation and user innovation.

After having built a definition reflecting the main features of Living Labs, we have set the theoretical boundaries of "what is a Living Lab". Nevertheless, it seems interesting to understand "what is not a Living Lab" and for that purpose, a comparison between four user innovation approaches will be developed in the following chapter in order to investigate the similarities and differences between Living Labs and three other approaches, namely the Fab Labs, the testbeds and the lead user method.

Chapter 3 – Comparison between four user innovation approaches

While the previous chapter aimed at defining what a Living Lab is, the objective of this chapter is to compare Living Labs with three other user innovation approaches: Fab Labs, testbeds and the lead user method. In this scope, we decided to focus on innovation methods involving users through experimentation. Hence, through this comparison, we will highlight the similarities but also the key differences between Living Labs and user innovation approaches gravitating around the studied concept. As a reminder, the definitions of Fab Labs, testbeds and lead user method can be found in the part 1.

1. Choice of criteria to make the comparison

In order to compare the four selected user innovation approaches, we identified eight criteria that could be interesting to highlight the key similarities and differences: (1) the context, (2) the potential selection of users, (3) the design method, (4) the user role, (5) the designer role, (6) the explored needs, (7) the presence of an infrastructure, and (8) the domains suited for the innovation approach.

The context in which the innovation process is led will be the first criterion. We make a clear distinction between two environments: realistic versus controlled environment. In a realistic environment, the innovation process takes place in natural, real life settings. In other words, within the users' usual life contexts, where everyday life is considered as an open system to the world where a variety of influences, constraints and opportunities can be manifested. Controlled settings refer to closed, artificial environments.

The potential selection of users will be the second criterion taken into consideration. Within user innovation methods, selection of users sometimes occurs. This selection may have various objectives. First, the aim could be to identify potential users or user groups depending on the contextualization, meaning the technological and social implications of the product or service under development (Pierson & Lievens, 2005). Such identification is usually done on a socio-demographic level through multiple approaches, such as selective sampling, criterion sampling, etc. (Pierson & Lievens, 2005). Second, selection can be used to gather a panel of different user types who will later be involved in the design process. In some cases, an optimal mix of users can be achieved by combining 'alpha users' with other panel members who have less experience (Seys et al., 2013). Third, the goal can be to identify lead users who lead the

market in terms of experience and intensity of needs (von Hippel, 1986). On the contrary, some methods do not require any selection among users.

The third criterion is the design method. According to Schuurman and De Marez (2017), there are three ways of involving users into the design process: (1) 'for users', (2) 'with users', and (3) 'by users'. These approaches diverge in terms of the place of the user within the design process, in other words on the link between the innovation and the user. First, the design 'for users' is based on knowledge retrieved from data and theories regarding the users (Schuurman & De Marez, 2017). Therefore, the design method 'for users' do not actively involve users in the innovation process. This method relates to the user-centered and the design-driven innovation methods, where the users only have a passive role. Second, in the design 'with users', the users are considered on equal ground with the designers and participate more actively in the process. Here, the users' ideas and feedbacks are valued and they are taken into account to develop the new product or service. This collaborative approach relates to the participatory design methods, which considers users as real co-creators. Third, in the design methods 'by users', the user is really considered as the source of the innovation and develop the product himself (Schuurman, Baccarne & Mechant, 2013). By leveraging on his own skills and knowledge, the user proactively proposes new solutions and drives the process with a high level of freedom (Schuurman, Baccarne & Mechant, 2013; Dell'Era & Landoni, 2014). This design method refers to the user-driven innovations, where the user is in control of the innovation process.

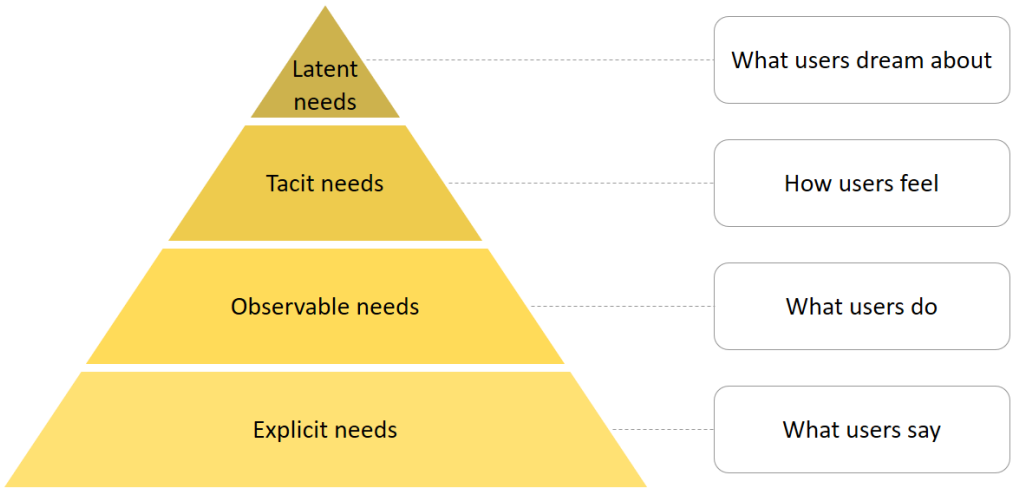
The next aspect that can be considered when comparing several innovation approaches is the role of users in the innovation process. As we already know, user involvement can take many forms and aims at empowering end-users to thoroughly impact the innovation process. Depending on the approach, users can have different roles, namely co-creators, testers, feedback-givers, communicators, observed subjects, and explorers of emerging ideas and innovative concepts. The definition of the user role will depend on the innovation method's objectives and the progress in the innovation steps.

The fifth dimension explored is the designer role within the design process. Depending on the design method and the role of users in the process, the designer can have different roles, such as framing the innovation problem, interpreting the user's behavior, translating the users' expressed needs into a robust solution, or leading the co-creation process (Dell'Era

& Landoni, 2014). The designer role can evolve during the innovation process, depending on the process requirements.

The needs explored by the different methodologies constitute the following criterion. Following the work of Sanders (2002), four different types of needs can be outlined: (1) explicit needs, (2) observable needs, (3) tacit needs, and (4) latent needs. First, explicit needs reflect what users say, while keeping in mind that the user only talk about what he wants us to hear. Second, observable needs refer to what users do and use; they can be detected with observation techniques. Third, tacit needs cannot be expressed in words, and represent how users feel and their know-how; this can be perceived through testing. Fourth, latent needs express what users wish and how they imagine a better future. Users' dreams can only be concretized when users directly build what they imagine (Sanders, 2002; Dell'Era & Landoni, 2014). The Figure 2 illustrates the different needs as well as their meaning. Different methodologies will therefore allow the detection of different types of needs. Our objective will be to identify what are the needs that can be detected through the four approaches: Living Labs, Fab Labs, testbeds and lead user methods.

Figure 2 **The different types of user needs**



Source: Adapted from Sanders (2002) and Dell'Era & Landoni (2014)

The penultimate criterion concerns the materialization of the innovation approach in an infrastructure. Amongst the different selected approaches, some of them require a specific infrastructure in order to be operational, while others are methodologies that can be implemented directly in a company for example. This aspect is closely linked to the duration

of those initiatives; the approaches characterized by an infrastructure will often be long-term initiatives, compared to methods than can be used as in punctual interventions.

The domains in which the innovation is designed will be the last criterion of the comparison. We will analyze if there are any sectors or domains that are more suitable to one approach or the other. Innovation can take place in a plethora of areas, such as the technology and digital field, education, health, social, energy, culture, mobility, Smart City, etc. Identifying the most appropriate type of projects for each innovation approach will be the objective here.

2. Comparison of the four approaches

In this section, we will highlight the key similarities and differences among the four approaches; Living Labs, Fab Labs, testbeds, and lead user method. The comparison will be performed for each of the criteria exposed in the previous section and this analysis will be summarized in the Table 6.

The first element that has been chosen to compare the four approaches is the context in which the innovation process occurs. As we already saw in this thesis, Living Labs are characterized by experimentation in real-life settings. As the father of the Living Labs already outlined in his definition, the Living Lab is a “research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts” (Niitamo, 2005). Indeed, the name of the concept is the best proof; the world “Living” relating to real-life settings. The idea is to leave the research laboratories to test services and products in the real life. In this way, users get in contact with the product/service in real conditions from which accurate insights can be captured. The three other methods, Fab Lab, Testbed, and Lead user methods, shape innovation in controlled environments. In a Fab Lab, creation occurs within the “Fabrication Laboratory” where machines are available to a wide range of actors. Testbeds are also non-realistic environments where innovation is tested in controlled settings with a technological deterministic view. In testbeds, users are observed in a recreated natural context within a laboratory milieu. Finally, lead user methods do not occur in real-life environments either. In this kind of initiative, designers rely on lead users’ deep knowledge, skills and proposals to develop the innovation in controlled environments.

The second criterion is the potential selection of users, which occurs in three of the four methods analyzed; namely the Living Labs, testbed, and lead user methods. However, the Fab Lab approach does not require any selection. Indeed, a Fab Lab is characterized by its

openness and is therefore accessible to everybody. Within Fab Labs, amateurs, students, professionals, entrepreneurs and others people come to test a personal idea, invent new usages, create a prototype, get knowledge from other participants and so on. On the other hand, Living Labs employ a certain form of selection. Indeed, a selection is needed to create an optimal mix of different types of users in Living Labs. Hence, the users' selection depends on the users' profiles and on the contextualization. Within testbeds, users test the innovation and provide feedbacks. A selection is made in order to target the right market and gather accurate and useable data, which will influence a potential market launch. In the lead user approach, lead users are the stakeholders desired to engage in the innovation process. The goal of the selection is thus to identify lead users who lead in terms of experience and intensity of need in the market.

In terms of the design method, the four approaches diverge. From our understanding of the concept, the design method set up in Living Lab is 'with users' given the active involvement of users through co-creation on the one hand, and on the other hand the fact that the users' ideas and feedback are valued in the same way as the other stakeholders' input in the ecosystem. In Living Labs, users and the other stakeholders are on equal footing and collaborate to build a new product or service together. In contrast, the users do not participate actively in the innovation process in testbeds. As a matter of fact, users are only involved since the prototyping phase to test the products and services under development and give their feedback, but they do not actively participate in the product creation. Therefore, we consider that testbeds have a design method 'for users'. Concerning the two last approaches, they follow a design method 'by users'. Firstly, the significant freedom characterizing Fab Labs gives the users the total control of the innovation process and permits the users to take all the decisions concerning the product development. Secondly, users are also at the center of the innovation process in lead user methods. By means of their expertise and their status of early adopters, lead users take the most important decisions in the innovation process. Those two approaches thus merge in terms of the design method, in contrast to Living Labs and testbeds.

Concerning the role of users in the innovation process, we observe that testbeds differentiate themselves from the three other approaches. The role of users in testbeds seems quite clear; they are observed subjects who test and give their feedback on the product or service under development. This role is quite passive, as they are not involved in a co-creation

process. Contrariwise, the Living Labs and Fab Labs make users participate actively in a co-creative process. On the one hand, users can have different roles in Living Labs depending on the step in the innovation process; from explorers of new ideas in the conceptualization phase, to testers and feedback givers in the experimentation phases. By being involved at each step of the innovation process, they are considered as active co-creators. On the other hand, users are also involved in Fab Labs at the early steps of the product or service development, at the time where the innovation takes shape. With the help of experts, they build their own project and are therefore considered as active co-creators as well. Lastly, we consider the users are real leaders in the lead user methods. As they propose breakthrough ideas that designers materialize into a prototype, they do not directly create their own product, but they lead the design process and test the prototypes under development to make sure that they fit to their needs and expectations.

The fifth comparison criterion is the designer role within the innovation process. Once again, a distinction can be made between Living Labs and Fab Labs on the one hand, and testbeds and lead user methods on the other hand. Within the two first approaches, the designer manages the co-creation process and collaborates with the users to build a solution that will fit to their needs. Also, the context is really important within those two approaches, where the manager leaves the users free to interact with the environment; whether characterized by real-life settings in Living Labs, or by a controlled environment making machines and tools available for users in Fab Labs. Hence, in those two approaches, designers are also considered as context designers (Dell'Era & Landoni, 2014). In testbeds, the designer role is mostly to interpret the users' needs through observation. Lastly, the designer acts as a translator in lead user methods, where his role is mainly to materialize the lead users' needs and expectations into a robust solution.

Regarding the users' needs explored by each innovation approach, the Living Lab approach is considered as the only one uncovering the four types of needs identified by Sanders (2002). Indeed, Living Labs can detect explicit needs through interviews, surveys or focus groups for instance, but they can also learn about the observable needs through observation in real-life settings, become aware of the users' tacit needs through testing, and get insights about latent needs through direct participation of users in the creation of prototypes. Within Fab Labs, there are mainly three types of needs that can be discovered;

observable needs, tacit needs and latent needs. We could firstly consider that Fab Labs can uncover observable needs by observing the usage made of the different machines available. Concerning tacit needs, they can be identified by letting the users iterate tests on their prototype until the achievement of the desired result. Also, latent needs can be detected by letting the users create what they dream of by themselves. In turn, testbeds uncover observable and tacit needs by observing the users testing the innovations within a controlled environment. Lastly, the lead user methodology permits to identify explicit needs and tacit needs. When lead users are involved in the process, they explain what they expect from the final product and describe their needs, which permit the designers and researchers to uncover explicit needs. Afterwards, when their needs are translated by designers, the innovative outcome is tested, leading to the detection of tacit needs. Following the work of Sanders (2002) on explored needs, we argue that in theory, the Living Lab is the most complete approach in order to uncover consumers' needs.

The seventh criterion is the materialization of the innovation approach in an infrastructure. Here, the lead user method is the only one that is not materialized in an infrastructure, compared to Living Labs, Fab Labs and testbeds. Indeed, from our understanding of the concept, lead user methods can be implemented punctually in a project that could take place in different settings, which is not the case of the other approaches. Concerning the Living Lab approach, as we already saw in the section 1 of the chapter 3, part 2, there is usually the presence of an enabler who invests in the Living Lab's infrastructure in order to carry out several projects on the long run. Therefore, we do not consider Living Labs as a method that could be used anywhere, but rather as a place where the ecosystem interacts on a longer period of time. The same argumentation applies for Fab Labs, where an external organism, such as a university or the government, invests in the Fab Lab's material, such as 3D printer, 3D modelling software, numerical control machines or electronic equipment. In testbeds, there are also resources invested in the setting up of a controlled experimentation environment that depicts the daily environment of users.

Finally, the last criterion concerns the several domains in which the four methods operate. Lehmann et al. (2015) report the scope of application of Living Labs in social, economic and knowledge fields, but specify that Living Labs can address issues from various perspectives, such as the questions of connectivity, trust and reciprocity that are fundamental

elements of co-creation. Until now, "Living Lab research has been used for technology development in a variety of fields, such as healthcare, agriculture, e-commerce, transport, tourism, and governance" (Baelden & Van Audenhove, 2015, p.845). Current Living Labs' projects are increasingly focusing on new emerging sectors, such as arts, local and regional development, lifestyle, security, textile, journalism, etc. (Dubé et al., 2014). Therefore, we can consider that Living Labs in general address a plethora of fields. Regarding the Fab Lab approach, most of the machines and tools available are digital, which limits the scope of application of Fab Labs towards technology and digital-oriented projects. In turn, testbeds seem as an interesting approach to test any product or service before the market launch. However, according to Dahlerups (2014) some challenges occur when using testbeds for the public-sector domains, such as education or healthcare, compared to mass markets. As a matter of fact, targeting users in those domains remains significantly complex and complementary technologies might be required for the testing (Dahlerups, 2014). Lastly, the lead user method is especially relevant when new product needs are evolving rapidly, as in many high technology product categories (Schuurman & De Marez, 2017). Von Hippel (1986) adds that fields subject to rapid change are particularly suitable for this kind of approach (von Hippel, 1986). As a matter of clarification, we summarized the main findings in the Table 6.

Table 6 – Summary of the comparison between Living Labs, Fab Labs, testbeds and lead users methods

	Living Lab	**Fab Lab**	**Test bed**	**Lead user method**
Context	Real-life	Controlled	Controlled	Controlled
Selection of users	Selection depending on users' profiles and contextualization	No selection	Selection based on market characteristics	Selection of lead users
Design method	With users	By users	For users	By users

User role	Active co-creator	Active co-creator	Tester and feedback-giver	Leader
Designer role	Co-creation manager and context designer	Co-creation manager and context designer	Interpreter	Translator
Explored needs	Explicit, observable, tacit and latent needs	Observable, tacit and latent needs	Observable and tacit needs	Explicit and tacit needs
Presence of infrastructure	Yes	Yes	Yes	No
Domains	Domain-agnostic	Mostly digital and numerical domains	Better suited for mass markets	Fast-moving markets

After a comparison between Living Labs, Fab Labs, testbeds and the lead user method, we notice that the Fab Lab approach shares numerous similarities with Living Labs, even if some differences exist. Those two collaborative approaches actively involve users in the process of creation and share knowledge and skills with other stakeholders engaged in the process. In this scope, the role of users as co-creators can be found in both approaches and represents a key characteristic of the development process. Also, the fact that some freedom is given to the users in order to interact with the environment is noticeable. Then, we observe that both approaches permit the identification of latent needs by letting users intervene directly in the product or service development. Lastly, both approaches are materialized into an infrastructure and carry out several projects on a long period of time. All these elements confirm the fact that Living Labs and Fab Labs are proximate in the user involvement environment.

3. Conclusion

This chapter proposed a comparison between Living Labs and three user innovation approaches gravitating around the studied concept. We thus now gathered more insights on what distinguishes Living Labs from other approaches. One of the main conclusion is that the Living Lab is the only out of the four approaches to test and validate products and services in real-life settings; the three other approaches shape innovation in controlled environments. Another distinguishing aspect of the Living Lab is design method “with user”, illustrating the fact that the contributions of users are valued in the same way as the contribution of other stakeholders. This is not really the case in testbeds, where users are considered as simple subjects of observation, neither in Fab Labs or in the lead user method, where users control and drive the innovation process. A last element that is worth to be mentioned is the fact that the Living Lab is the only method addressing all the users’ needs categories proposed by Sanders (2002). This is directly linked to the fact that the Living Lab covers the whole innovation process, from the ideation until the commercialization. Therefore, different needs can be detected at different steps of the innovation process.

The next part will focus on the mechanisms happening within Living Labs. In other words, the goal will be to understand how Living Labs work.

Part 3 - How Living Labs work

In this part, we will explore the literature on Living Labs to understand how Living Labs work concretely. For that purpose, the emphasis is set on the relationships and mechanisms taking place within Living Labs organizations. First, we will investigate the roles of the different stakeholders involved in Living Labs. Second, innovation processes enhancing new products and services within Living Labs will be outlined. Third, Living Labs methods aiming at involving users at each stage of the development process will be presented.

Chapter 1 - Roles of the stakeholders in the ecosystem

In our definition, we highlighted that partnerships between the public sector, the private sector and the citizens are at the heart of Living Labs. In this scope, multiple stakeholders from several sectors take part in the Living Lab activities having different roles with respect to the product development. According to Sarjanen (2010), there exist mainly four interdependent roles in Living Labs: (1) users, (2) enablers, (3) utilizers and (4) providers. In this chapter, we will describe those four categories and base ourselves on the classification made by Leminen, Westerlund and Nyström (2012) to understand the different types of Living Labs depending on which actor drives the innovation activities. Generally, a particular group of stakeholders, among the users, enablers, utilizers and providers, is the principal promoter of the innovation activity in Living Labs (Leminen, Westerlund & Nyström, 2012).

Firstly, end users come from the people (or citizen) sphere of the partnership in Living Labs. They express needs or desires to enablers in the objective of promoting the creation of innovation initiatives, such as Living Labs, in order to develop products or services that would answer their unsatisfied needs. If the enabler answers their request, users will be involved in the innovation process in order to test and co-create products and services. Sarjanen (2010) add that they do not need to dispose of a specific expertise in order to fit in, but they have to be open and give an honest feedback on the product or service in development. By engaging in Living Labs' projects, users provide a know-how that could not be acquired in internal laboratory testing (Sarjanen, 2010). According to Leminen, Westerlund & Nyström (2012), users are generally not the group of stakeholders who drives the innovation process, but they can still set up Living Labs in order to solve their daily problems, which would then lead to the emergence of a user-driven Living Lab. The authors explain that in user-driven Living Labs, the

end-user drives the innovation process in order to resolve specific issues in a coherent way with the values and the requirements of the user communities. User-driven Living Labs therefore highlight the development needs of a specific community of interest, such as a hobby group or a local housing community. Companies and the society in general indirectly benefit from the value co-created but the user communities are the privileged target of the value returns (Leminen, Westerlund & Nyström, 2012). The authors add that activities within user-driven Living Labs are quite informally organized. In fact, the users or user communities do not manage the Living Lab and its operations even though they drive the innovation process. They argue that their bottom-up structure does not permit user-driven Living Labs to be managed as such and other stakeholders in the ecosystem should support the users by providing knowledge, resources and advices. Therefore, operations are facilitated by a provider and a utilizer who influence users and their actions. As a result, the innovation outcome can be exploited and commercialized by utilizers later on (Leminen, Westerlund & Nyström, 2012).

Secondly, enablers are the one at the origin of the infrastructure and the policies that provide an adequate environment for the involvement of stakeholders in the Living Lab. Enablers generally come from the public sector; they do not participate actively in the Living Lab's activities but they help financing innovation initiatives. This funding is essential to Living Labs, without which the private companies would not develop products and services due to the uncertainty of the project results (Sarjanen, 2010). Enablers therefore invest in the setting-up of the Living Lab and communicate the objectives to utilizers. According to Leminen, Westerlund and Nyström (2012), enablers can support societal improvements projects through the creation of enabler-driven Living Labs, with the objectives of solving social issues or reducing local unemployment for example. In that view the regional or societal needs are at the heart of the development of new products and services. The collaboration between multiple stakeholders in the Living Lab is key to success, but the participation of private companies remains quite minimal within enabler-driven Living Labs. Indeed, mostly users, universities and other educational bodies are involved in those kinds of projects. This low level of investment from the private sphere could be explained by non-obvious potential commercial advantages for the utilizers. Indeed, "companies fail to see the value of participating in those kinds of living labs that target mainly enabler's objectives and focus on creating value for the enabler" (Leminen, Westerlund & Nyström, 2012, p.9).

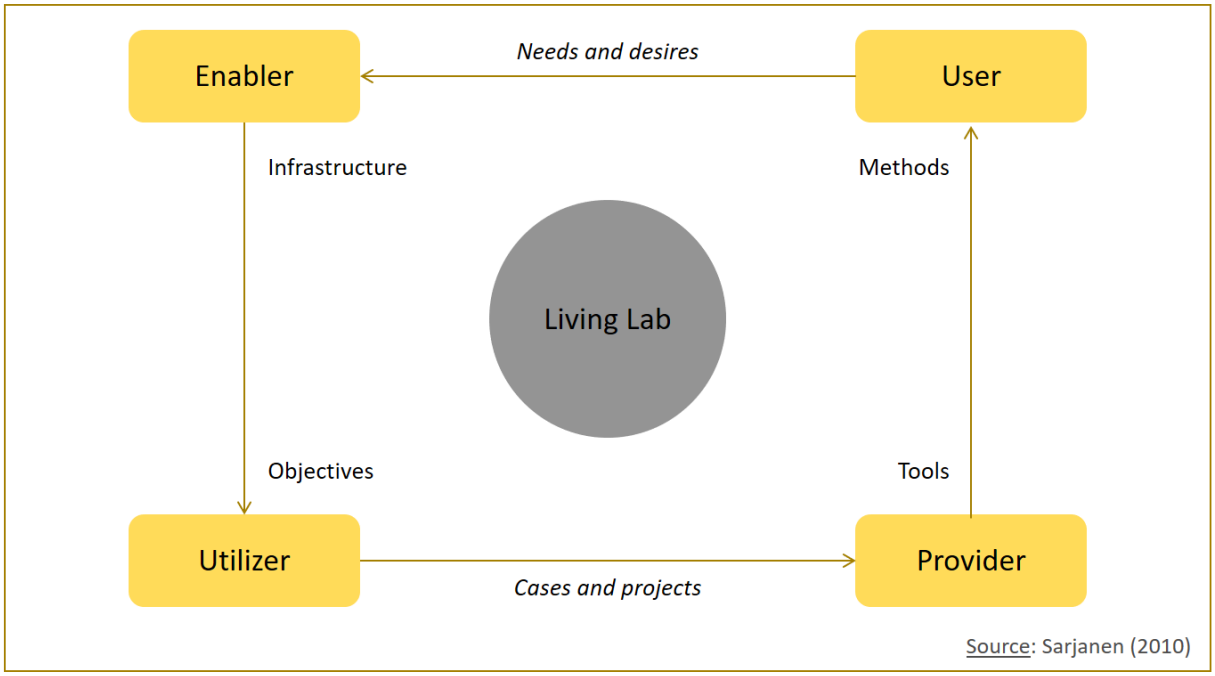
Then, utilizers are usually companies coming from the private sector, but they can also come from the public sector. They benefit from the infrastructure implemented by the public sector in order to develop their products and services (Sarjanen, 2010). Based on the objectives communicated by the enablers, the utilizers will develop a project that will take place in the Living Lab and can participate actively in the implementation of their project with the end users (Sarjanen, 2010). Leminen, Westerlund and Nyström (2012) explain that the main objective of utilizer-driven Living Labs is to expand and test the company's products and services in order to create value predominantly for utilizers with the help of the Living Lab's ecosystem. In this type of Living Lab, the utilizer is the main actor and organizes Living Lab activities around its own business. Yet, utilizer-driven Living Labs are often short-lived due to the fact that utilizers seek for quick results strengthening their business strategy. The authors argue that "Living labs initialized by a utilizer are linked with strategic actions in the firm's product-development function" (Leminen, Westerlund & Nyström, 2012, p.9). Thus, research activities are seen as a strategic tool with the objective of observing users and collecting data on the product or service usage. Such user information on trends, usage experiences or even on the competitors is gathered to sustain the companies' development on the short and the long run (Leminen, Westerlund & Nyström, 2012).

Finally, the Living Lab cannot be complete without the intervention of providers, who will share their human and technological resources, as well as tools and methods with the other stakeholders in order to promote the project implementation. Providers are generally universities or other research and education institutes. They can come from either the private or the public sector. The methods and tools they provide will be used to gather data from users' comments, feedback and suggestions in order to be analyzed by the developers. The insights retrieved from those data will be communicated to the utilizers in an agreed form (Sarjanen, 2010). According to Leminen, Westerlund and Nyström (2012), diverse development bodies usually launch provider-driven Living Labs in the objective of promoting research and knowledge creation in order to find solutions for particular issues. For example, Living Labs are used by some universities for educational purposes by pursuing the development of new research or teaching methods. The specificity of these Living Labs is that knowledge and information generated by the innovation process are useful and valuable for each member of the ecosystem. Those benefits include new research results, practical commercial solutions or improved solutions for daily issues and could vary depending on the

participants. Nevertheless, the authors outline that providers could struggle to attract utilizers and enablers within the ecosystem. In terms of duration, provider-driven Living Labs are challenged by the fact that companies usually matter about quicker development cycles and fast results (Leminen, Westerlund & Nyström, 2012).

Those four types of stakeholders, coming from the private, public and people sphere, are essential for the project to operate properly and form this private-public-people partnership. Sarjanen (2010) explains that if one of the participants is missing, the project cannot generate the best possible results. Also, the fact that each opinion is seen in the same way and that the different stakeholders are on equal ground is essential in order to promote continuous and constructive discussions and interactions (Sarjanen, 2010). Leminen, Westerlund and Nyström (2012) confirm this aspect and state that no hierarchical power is exercised by the dominant actor over the others participating as well in the innovation process. Also, it is interesting to note that most of the Living Labs are either utilizer-driven or provider-driven in practice, as these two approaches focus on efficiency and firms' investments (Leminen, Westerlund & Nyström, 2012). The Figure 3 summarizes the relationships between the four categories of stakeholders. Also, the main characteristics of each type of Living Lab are summarized in the Appendix 5.

Figure 3 **Roles of the stakeholders in the ecosystem**



Source: Sarjanen (2010)

In this chapter, we have reviewed the four main groups of stakeholders taking part in the Living Lab's activities through a private-public-people partnership. We also learned from the work of Leminen, Westerlund and Nyström (2012) that the Living Lab's main objectives will differ depending on the Living Lab driver, which can be one of the four main stakeholder groups. In the next chapter, we will explore the different innovation processes in which those participants interact.

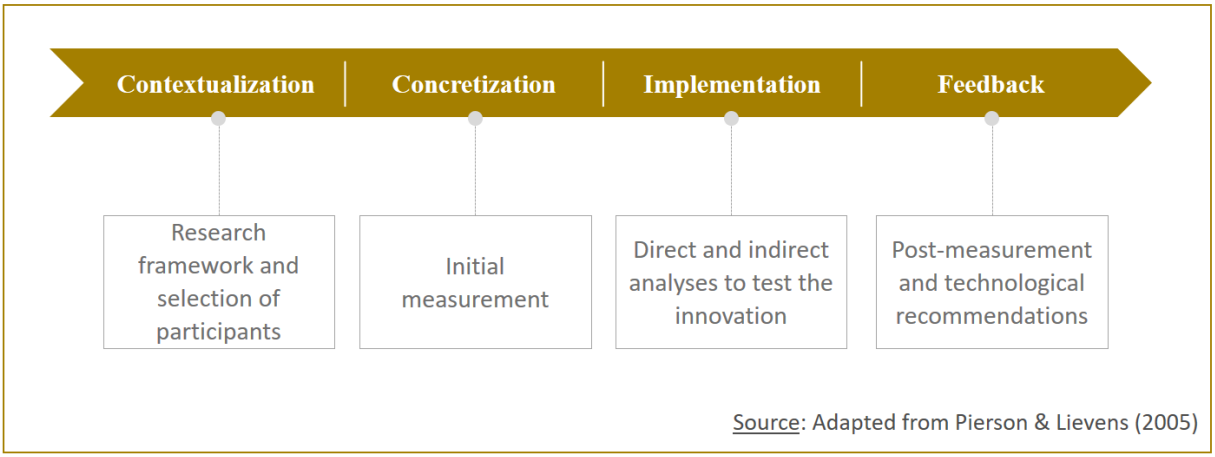
Chapter 2 - The innovation process

In this chapter, we will first explore the two main types of innovation processes that can be implemented in Living Labs derived from the work of Pierson and Lievens (2005) and Ståhlbröst and Holst (2012): (1) a phased approach, and (2) an iterative approach. Then, we will briefly explore the innovation processes on the field reality through the work of Almirall, Lee and Wareham (2012) and through our interview with M. Schuurman in order to compare innovation processes as exposed in the literature to innovation processes as set up in reality.

1. The phased innovation process

A phased model illustrating the innovation process in Living Labs has been proposed by Pierson and Lievens (2005). Their model is illustrated in the Figure 4 and is composed of four phases: (1) contextualization, (2) concretization, (3) implementation and (4) feedback (Pierson & Lievens, 2005).

Figure 4 The four-phase innovation process



Source: Adapted from Pierson & Lievens (2005)

According to the authors, the contextualization phase starts by defining the research framework and identifying the potential respondents. The aim is to explore the technological and social dimensions in order to compare what is technologically feasible with what is socially

achievable (Pierson & Lievens, 2005). Seys et al. (2013) add that this can be done with the help of several methods, such as scanning trends and relevant academic researches, investigating the available technologies, gathering experts' opinions, but also by carrying a large-scale users study and by making use of selective sampling methods.

When it comes to the concretization phase, Pierson and Lievens (2005) explain that the users' characteristics, as well as their daily behavior and their perception towards the research objective are analyzed. Those elements permit an initial measurement before any active participation in the project in order to get a snapshot that will be compared later on with a post-measurement performed at the end of the project (Pierson & Lievens, 2005).

The implementation phase is the actual Living Lab operational test phase. According to Pierson and Lievens (2005), the objective at this stage is to gather information on the innovation usage, meaning, adoption and motivation. This data gathering process is carried out with complementary direct and indirect analyses. On the one hand, direct analysis uses basic ethnographic methods as well as tools to register all the relevant users' actions in order to get insights regarding the innovation usage. On the other hand, indirect analysis uses several research methods, such as focus groups, self-reporting techniques and in-depth interviews (Pierson & Lievens, 2005).

The last step is the feedback phase, which consists of a post-measurement and several technological recommendations regarding the innovation. Firstly, the post-measurement's goal is to measure the users' perception and attitude towards the innovation in order to identify a potential evolution compared to the initial measurement undertaken at the concretization phase. This permits to assess changes regarding the technology usage in a real-life environment. Secondly, the technological recommendations are based on the findings of the implementation phase. The data gathered and analyzed permits to identify user profiles and user patterns useful to understand the users' needs and translate them into technological requirements (Pierson & Lievens, 2005).

2. The iterative innovation process

Ståhlbröst and Holst (2012) developed a model called "FormIT" to illustrate the iterative innovation process that supports Living Labs' activities. This model includes several loops, or iteration cycles, that aim to re-examine the users' needs continuously since they can change as users gain more knowledge into possible solution. Also, cross-functional interaction

is promoted to share knowledge across different fields and facilitate innovative ideas. According to them, each project in a Living Lab is carried out in five major phases: (1) planning, (2), concept design, (3) prototype design, (4) innovation design, and (5) commercialization (Ståhlbröst & Holst, 2012).

During the first phase, the authors emphasize the importance of gathering information about the underlying circumstances in order to obtain a good mix of competencies to stimulate knowledge sharing. At this stage, a good understanding of the stakeholders' visions is required to decide what to include or exclude in the intervention, how to create value for the users, how openness should take form, etc. The authors also stress the importance of planning phase as users can make a strong contribution in terms of the project direction. Also, this phase creates the foundation for the rest of the process and it can thus become difficult and expensive to correct mistakes in later stages (Ståhlbröst & Holst, 2012).

During the second phase, the work starts with the identification of needs and ends with the validation of a designed concept. For that purpose, the scope of the process and the target-user group should be defined, as well as the roles of users in the process. Then, the basic needs, the values and the behavior of the different stakeholders should be identified through stories or dreams telling for example. After the data collection, the results are analyzed and translated into concepts that reflect the basic objective of the innovation. If all stakeholders agree with the concept, the process can move on to the next phase; otherwise, the cycle needs to be reiterated until coherence is achieved between the needs and the concept (Ståhlbröst & Holst, 2012).

During the third phase, the objective is to build a prototype by defining the basic functions, workflows and interfaces of the innovation. This is firstly done by using data gathering methods in order to get the users' input through interviews and observations. Once the prototype has been designed, the interaction between the user and the prototype permits users to evaluate it based on usability aspects, such as effectiveness, simplicity and pleasure of utilization (Ståhlbröst & Holst, 2012).

The fourth phase starts with the analysis of the insights resulting from the usability evaluation. The users' feedback reflects mainly their feelings and their experience with the innovation. Thus, objective usability goals are not always reflected in the usability evaluation, such as the usefulness or the productiveness of the innovation. The results of the evaluation

can require small adjustments concerning the needs of the innovation, but especially changes in the design of the innovation. After those adjustments, the development work is finalized (Ståhlbröst & Holst, 2012).

The final phase is the commercialization of the innovation, where the identification of potential buyers and the assessment of the market potential of the innovation are two key components. According to Ståhlbröst and Holst (2012), this step can also be seen as a separate project where adoption of the innovation depends on a variety of conditions, namely learning, social and technological considerations. The behavior of adopters will therefore be influenced by those conditions, which depend on the context in which the innovation is commercialized (Ståhlbröst & Holst, 2012).

Lehmann, Frangioni and Dubé (2015) drawn from the work of Ståhlbröst and Holst (2012) to elaborate an adapted version of the FormIT model. According to them, each phase in the innovation process conduct four types of activities: (1) co-creation, (2) exploration, (3) experimentation, and (4) evaluation, which can be repeated multiple times until the evaluation is completed (Lehmann, Frangioni & Dubé, 2015). We will develop hereafter the four types of activities (co-creation, exploration, experimentation and evaluation) taking place at each phase of the project development based on the work of Dubé et al. (2014). Co-creation is the first activity that is carried out at each phase of the innovation process. This step aims to bring the users and all the other stakeholders together in order to generate new ideas and develop solutions. According to Dubé et al. (2014), it is important to understand the users and their context of life by creating spaces for consultation and dialogue, as well as a climate of trust through a series of lively workshops. As the users' needs stimulate the creative process, it is of primary importance to put the emphasis on the users' desires, fears and experiences with the prototypes, rather than on functional requirements. In this scope, users are really considered as creators and it is therefore important to provide them adequate tools to contribute to the process of designing new solutions (Dubé et al., 2014).

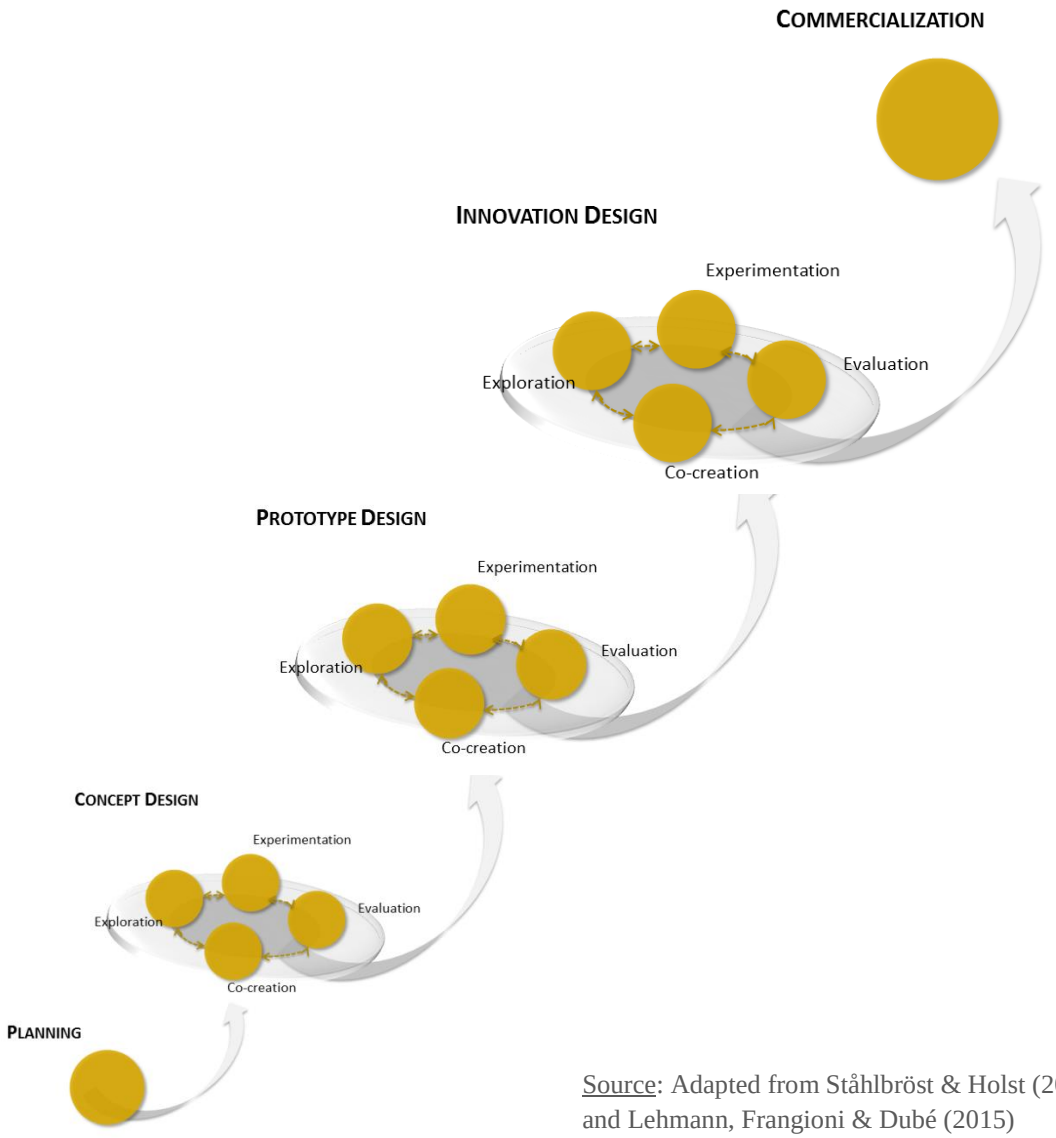
The second step is to discover new uses, behaviors and market opportunities for the development of new products or services by means of exploration activities. At this stage, Dubé et al. (2014) state that the ideas derived from the co-creation activities should be used to create scenarios with the help of experimental modeling tools. External experiences are also brought by the management team to facilitate or inspire user experiments. Then, by

comparing the use scenarios with realities on the ground, a common sense can be built around the project in a more in-depth way. However, in hospitals and public spaces, many constraints related to ethics, security and infrastructure could limit the scope of experimentation of product or services scenarios (Dubé et al., 2014).

The third step is to test the solutions developed in real-life conditions through experimentation activities. For that purpose, Dubé et al. (2014) argue that the development of more or less refined supports are required to enable users to test the prototypes and collect observations on the uses and behaviors of adoption. The more we move forward in the phases of the innovation process, the more complex and mature the prototypes used for the experimentations are and the more integrated within their own living environment the users are (Dubé et al., 2014).

In order to validate the potential of developing a specific product or service, evaluation activities need to be completed at each phase of the innovation process. According to Dubé et al. (2014), three dimensions should be approached to maximize the alignment of innovation with the needs and desires of the users: (1) the meaning of use, (2) the situations of use, and (3) the context of use. Firstly, the meaning of use, that is to say the meaning that the user gives to the use of the product, service or technology, is observed. It is a question of understanding how the user portrays the tools, the functionalities and the know-how necessary for the use. Secondly, we observe the situations of use, the situations that give rise to the use. It is a matter of concretely observing how users adapt innovation to their needs according to the situation encountered. The aim is to identify the conditions for the adoption of innovation by users in their life contexts. Thirdly, the context of use, the socio-professional characteristics of the users, and the economic and social context in which the use is inserted is observed. It is a question of exploring the conditions of appropriation (Dubé et al., 2014). The Figure 5 on the next page illustrates this iterative innovation process based on the work of Ståhlbröst & Holst (2012) and Lehmann, Frangioni & Dubé (2015).

Figure 5 The iterative innovation process in Living Labs



Source: Adapted from Ståhlbröst & Holst (2012) and Lehmann, Frangioni & Dubé (2015)

While the phased approach and the iterative approach appear to be the two main innovation processes implemented in Living Labs, the field reality shows that several Living Labs have customized the theoretical models (Almirall, Lee & Wareham, 2012). In the following section, we provide three examples of such customized innovation processes.

3. Customization of innovation processes

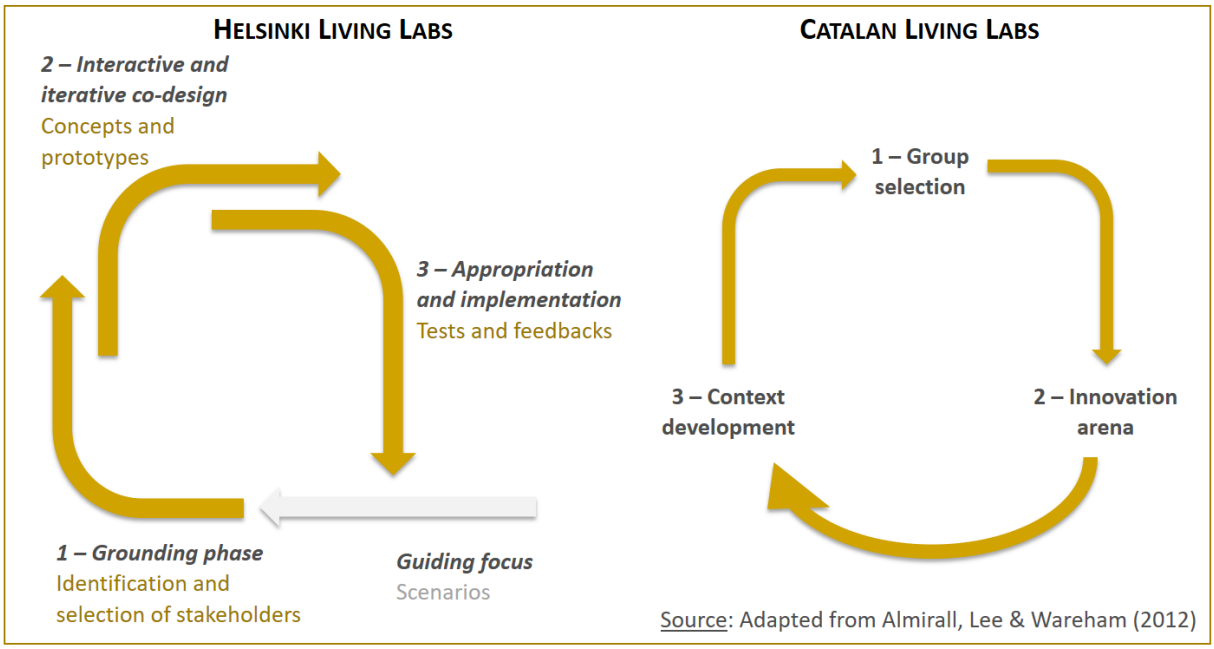
On an empirical point of view, several Living Labs have customized the theoretical models in order to tailor them to their specific context and requirements. Two main empirical examples have been described by Almirall, Lee and Wareham (2012): (1) Helsinki Living Labs,

and (2) Catalan Living Labs, illustrated in the Figure 6. Besides those two examples coming from the literature, we will describe Imec iLab.o's innovation process based on the insights gathered during our interview at Imec iLab.o Living Lab.

On the one hand, Helsinki Living Labs built a three-phase process evolving in a spiral: (1) grounding phase, (2) interactive and iterative co-design, and (3) appropriation and implementation. The first phase consists of the identification and selection of users and stakeholders. The second phase is the conceptualization and prototyping of the innovation based on the users' needs. Finally, during the third phase, the final prototype is tested and the users' feedback is collected (Almirall, Lee & Wareham, 2012).

On the other hand, Catalan Living Labs do not focus on exploring the users' needs, but they rather spotlight the implementation in real-life environments. Catalan Living Labs therefore set up a different three-phase process: (1) group selection, (2) creation of the innovation arena, and (3) context development. The first phase consists of selecting the right set of users in order to foster innovation but also market demand. The second phase focuses on demonstrating the innovation's viability in real-life settings through the usage of state-of-the-art infrastructure, such as high-speed internet research networks and high-end sensor networks. The objective here is to foster the market demand and reduce market risks. During the third phase, experimentation in daily environments takes place, as well as the development of sustainable business models (Almirall, Lee & Wareham, 2012).

Figure 6 **Empirical cases of process customization**

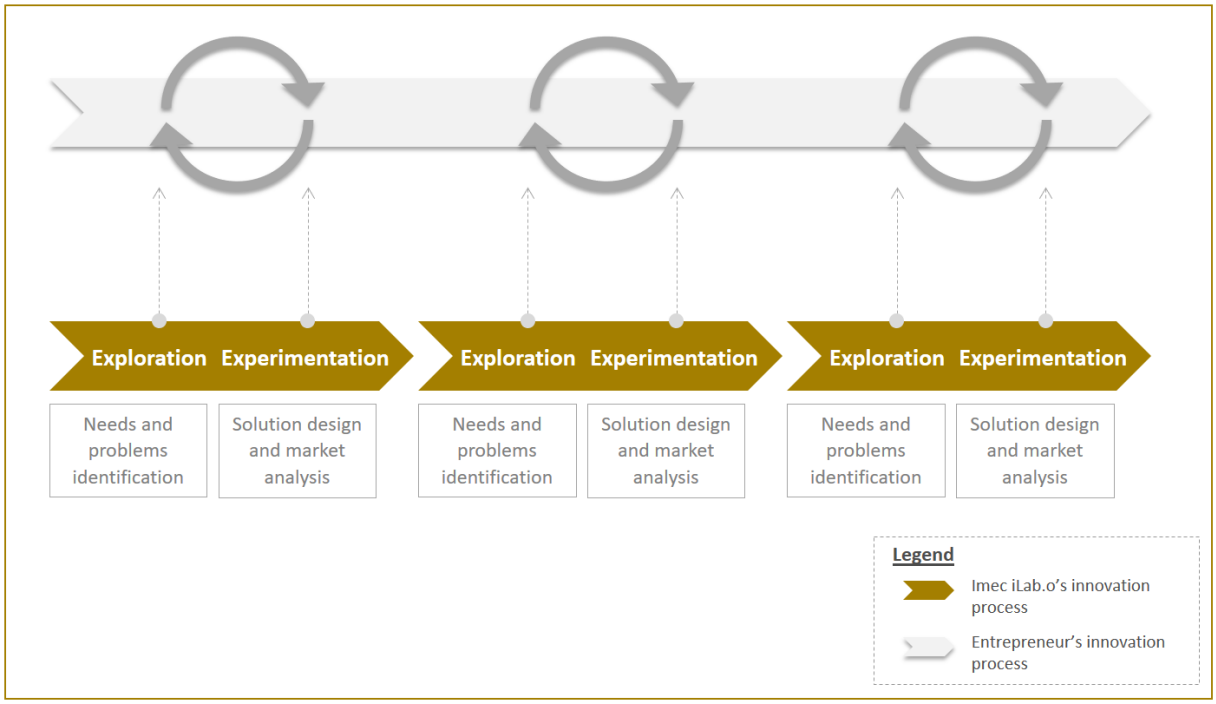


Source: Adapted from Almirall, Lee & Wareham (2012)

Another example of process customization can be illustrated with the Living Lab Imec iLab.o. As we understood from our interview with M. Schuurman, team leader of the user expertize at Imec iLab.o, their Living Lab also customized the two theoretical models presented in the previous sections in order to fit to their specific context and environment. As a first step, Imec iLab.o implemented a phased innovation process in its Living Lab in Belgium based on the work of Pierson and Lievens (2005). However, Imec iLab.o decided simplified this innovation process into two stages: (1) the exploration stage, and (2) the experimentation stage. According to Imec iLab.o, the exploration phase is about identifying what are the users' needs and what are the problems to be solved. Secondly, the experimentation phase is about defining the solution to be offered to users, finding the most suitable mean to solve the problems, and analyzing the potential market for the solution. These are the big two stages followed at Imec iLab.o, which sometimes get a little bit mixed according to M. Schuurman. As an example, the observation in real-life settings is taking place in the experimentation stage to identify the practices and the habits.

Moreover, Imec iLab.o customized this phased process by using an iterative methodology and reiterating the steps as long as necessary until the fulfilment of their objective (Figure 7).

Figure 7 **Imec iLab.o's innovation process**



As Imec iLab.o mostly works with entrepreneurs who are already developing their own innovation process, Imec iLab.o's support can be seen as an additional process complementary to the entrepreneurs' own process. In other words, Imec iLab.o intervenes, helps entrepreneurs and gives them inputs to develop their own innovation process. This represents one of the reasons why Imec iLab.o innovation process is closer to the phased model, as the iteration happens on the entrepreneurs' side. While Imec iLab.o gives inputs, entrepreneurs iterate and take the control of the innovation process. Nevertheless, it has to be said that Imec iLab.o is more and more moving towards the iterative model in order to gather extensive freedom and hence enhancing co-creation between development people, users and researchers.

In this chapter, we observed that even though there are two clear theoretical innovation processes presented in the literature – the phased model and the iterative model -, Living Labs do not always use them as they are but rather customize them to answer their regional and project requirements; such is the case for Helsinki Living Labs, Catalan Living Labs and Imec iLab.o. This illustrates the divergences of processes used amongst Living Labs. In the next chapter, we will look briefly at the methods used during the theoretical phases of the innovation process in Living Labs in general in order to understand what tools they use to interact with users and other stakeholders.

Chapter 3 - Methods used in Living Labs

In this chapter, we will look at the work of Schumacher and Feurstein (2007) and Feurstein et al. (2008) to understand what tools and methods are used to foster the user involvement and the co-creation at each stage of the iterative innovation process. According to Schumacher and Feurstein (2007), the Information and Communication Technologies (ICT) have influenced the methods used in Living Labs and it has been seen as an opportunity to increase the degree of interaction with users and to reach a bigger community of users. In that view, several new methods aiming at involving users in the development process have emerged; the so-called Collaborative Working Environment (CWE) methods. The authors argue that these methods seem highly appropriate tools for existing and emerging Living Labs (Schumacher & Feurstein, 2007). Table 7 summarizes the traditional and the CWE methods that are used in Living Labs at each stage of the innovation process, from the planning and idea generation to the commercialization of the innovation.

Table 7 - Methods used in Living Labs to foster user involvement

Phase in the innovation process	**Traditional methods**	**Collaborative Working Environment methods**
Idea generation	• Customer complaints • Interviews • Focus Groups • Empathic Design • Participatory Design • Story Telling • Customer Suggestions • Idea Generation with lead-users • Creativity Groups	• Online Interviews • Online Focus Groups • Online Suggestion Box • Online Creativity Groups • Market Intelligence Service
Concept design	• Conjoint Analysis • Quality Function Deployment	• Web-based Conjoint • Analysis • User Design

	matrixConcept Tests with lead users • Ethnography methods	
Prototype design	• Workshops with customers • Prototype Testing • Usability Tests • Field Trials • Engineering Contests	• Dynamic Social Network logging • Experience Sampling • Method • Virtual Prototype Tests • web-based CAD • User Toolkits
Innovation design and commercialization	• Product Testing • Test Markets • Usability Tests	• Eye-tracking • Time-motion-studies • Virtual Product Tests • Virtual Test Markets • Virtual Prototype Tests

Source: Adapted from Schumacher & Feurstein (2007) and Feurstein et al. (2008)

As we can see from the Table 7, an important number of methods can be implemented in Living Labs at each stage of the innovation process. Therefore, depending on the progress in the innovation process, different methods will be used to involve users in the process. We can deduce from the Table 7 that communicative methods, such as focus groups, storytelling and interviews, tend to be used at the early steps of the innovation process. In those kind of methods, users are involved and we can consider that they contribute significantly at the early steps, but in a passive way. During the concept design stage, we understand that Living Labs use statistical methods, such as conjoint analysis, as well as observation and behavior analysis methods, such is the case for ethnography methods and the Quality Function Deployment matrix. During this second stage, we thus presume that the users are less involved than during the first stage, except for the lead users who participate in concept tests. Lastly, we also observe that the last steps of the innovation process use mainly testing and co-creation methods, such as workshops with users, prototype testing, field trials or usability tests. In

those methods, users are actively involved to collaboratively participate in the innovation creation and in the innovation testing and validation.

As a conclusion, whether virtually through CWE methods or face-to-face through traditional methods, there exist multiple ways to get the users' input in the process; from communicative methods, observation, statistical analysis, to co-creative and testing methods, the users' activeness is more and more emphasized as the innovation process moves forward.

Conclusion

In this part, we gathered some insights on how Living Labs work concretely. Through the work of Sarjanen (2010) and Leminen, Westerlund and Nyström (2012), we understood that four main actors lie behind the public-private-people partnership: end-users coming from the people sphere and participating actively in the innovation process, enablers coming from the private sector and providing the infrastructure and policies, utilizers who typically are companies coming from the private sector and who develop their next product or service in the Living Lab, and finally providers coming from universities or other research institutes and sharing methodologies, as well as human and technological resources to generate new knowledge in the Living Lab. The Living Lab's main objectives will differ depending on the Living Lab driver, which can be one of the four main stakeholder groups. Those four groups interact and develop new products and services together through an innovation process, that can be theoretically either a phased process or an iterative process. Nevertheless, we observed that in practice, Living Labs often customize their innovation process to answer their regional and project requirements. Within each step of the process, we also understood that different methods and tools are used, from communicative methods, observation, statistical analysis, to co-creative and testing methods. Thus, we concluded that the users' activeness is more and more emphasized in the methods and tools as the innovation process moves forward. All those roles, relationships, processes and methods form together the innovation environment of Living Labs.

Part 4 – Contexts justifying the Living Lab implementation

In this part, the objective will be to identify the most suitable fields and contexts to implement a Living Lab. This part is divided into two chapters: (1) Scope of application, (2) Development of a fit assessment model. The first chapter aims to determine the types of projects and fields that are suitable for the implementation of Living Labs. The second chapter will go through an in-depth comparison of two similar concepts; the Living Lab and the Fab Lab, in order to understand concretely what are the specific contexts justifying the implementation of a Living Lab. This last chapter will also study two empirical cases, Imec iLab.o and Makilab, in order to verify the robustness of the fit assessment model developed.

Chapter 1 - Scope of application

In this chapter, we will explore briefly the literature to learn about the types of projects launched in Living Labs and the sectoral profiles of Living Labs. At the end of the chapter, we will also explore the limits of application of Living Labs' initiatives.

1. Types of projects suitable for Living Labs initiatives

When we explore the literature to understand the types of projects launched in Living Labs settings, we observe that there are diverging opinions. For Schumacher, Feurstein and Gschweidl (2009) on the one hand, Living Labs can be a place suitable for both business-to-business (B2B) and business-to-consumer (B2C) projects (Schumacher, Feurstein & Gschweidl, 2009). On the other hand, Bergvall-Kåreborn et al. (2009) argue that Living Labs' project are exclusively in B2C as they focus on products and services creation, and the authors therefore place Living Labs out of the scope of open innovation, focusing on B2B projects and relying on external sources of knowledge in the business model (Bergvall-Kåreborn et al., 2009, cited in Schuurman, De Marez, & Ballon, 2015). However, as we argued at the beginning of this thesis, we decide to place Living Labs between the open innovation and user innovation approaches; not being exclusively the sub-category of one line of though. We thus decide to step back from Bergvall-Kåreborn et al.'s opinion. As the literature seems to have diverging opinions, we looked further at concrete examples of Living Labs' projects via the work of Coorevits and Schuurman (2014) and Schuurman (2015). Our first observation is that amongst the four empirical examples analyzed in the work of Coorevits and Schuurman (2014), there are two instances of B2C cases and two instances of B2B cases. The work of Schuurman (2015)

provides more examples of projects in several Living Labs, including LeYLab, Mediatuin, iMinds and FLELLAP. Throughout the examples, we observe many cases of B2C Living Labs and B2B Living Labs, but also B2B2C Living Labs. The latter can be illustrated with the InCitys platform project realized at FLELLAP Living Lab, where both businesses, such as shops, service providers, etc., and citizens were users of the platform, leading to the B2B2C project status. Also, we observed that several projects switched from a B2C focus towards a B2B focus, such is the case of the Poppidups project launched at LeYLab when they realized that the user interest and their willingness-to-pay were actually lower than expected (Schuurman, 2015). We conclude from those empirical examples that B2B, B2C and B2B2C projects are all in the scope of Living Labs.

Then, the work of Ståhlbröst (2013) highlight the fact that Living Labs represent a significant opportunity for micro-, small-, and medium-sized enterprises because of their limited resources, competences, or vision (Ståhlbröst, 2013). Feurstein et al. (2008) add that the Living Labs' projects often coincide with the regional development policy or the core regional industry sectors (Feurstein et al., 2008). Hence, we understand that Living Lab initiatives are more suited for regional needs and SMEs.

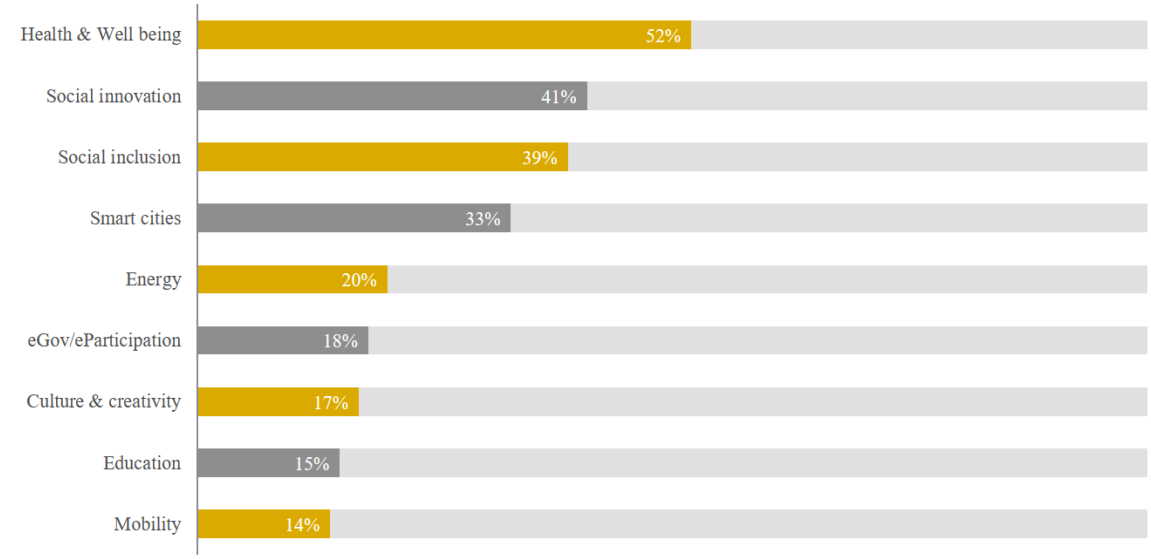
Concerning the duration of the projects, the opinions of different practitioners converge. Fosltad (2008) argues that Living Labs conduct medium- or long-term studies involving users. Ogonowski et al. (2012) also insist on the long-term involvement of users but brings the light on the challenges related to this long-term perspective regarding the users' motivation, the relationship, and the coordination of collaboration. They add that "keeping the participants' motivation on the same high level over the entire life-span of the project is an essential task for the operator of a Living Lab" (Ogonowski et al., 2012, p. 1545). Juujärvi and Pesso (2013) highlight the role of Living Labs' participants to create shared long-term goals and prioritize them over short-term benefits. They also add that the users' real needs will become evident in a long-term collaboration and that it is more rewarding for users to participate in a long-term innovation process, rather than short experiences. They go further and state that the knowledge accumulated through the research process permits to develop new innovations in a more effective manner in the long run (Juujärvi & Pesso, 2013). Liedtke et al. (2011) add a sustainable dimension related to the long-term perspective of Living Labs. In their work, the authors argue that Living Labs are suited for long-term and cross-cultural

research, which make them highly relevant to foster innovation in sustainable lifestyles and products (Liedtke et al., 2011). This section gathered several insights on the types of projects suitable for Living Labs. In the next section, we will explore the literature, as well as ENoLL's statistics to learn more about the sectoral profiles of Living Labs.

2. Sectoral profiles of Living Labs

For several decades, Living Lab initiatives have emerged in a various range of domains. Lehmann et al. (2015) report the scope of application of Living Labs in social, economic and knowledge fields, but specify that Living Labs can address issues from various perspectives, such as the questions of connectivity, trust and reciprocity that are fundamental elements of co-creation (Lehmann et al., 2015). Until now, "Living Lab research has been used for technology development in a variety of fields, such as healthcare, agriculture, e-commerce, transport, tourism, and governance" (Baelden & Van Audenhove, 2015, p.845). Even if Living Labs' projects can concern various emerging sectors, such as eHealth, eTransportation, Smart City, ICT for energy and environment (Pallot et al., 2010), they are still attractive for traditional industries given the fact that it does not reinvent the conventional innovation process, but rather extends it (Leminen & Westerlund, 2011). Those contributions make us consider the Living Lab as a domain-agnostic innovation ecosystem, even though there seems to be more and more Living Labs focusing on societal issues, such as eCare, eInclusion, eHealth, etc. (Pallot et al., 2010). This is mainly due to the fact that a growing number of health regional agencies and authorities support and finance Living Labs in health and autonomy (Picard, 2015). In order to understand more in depth the different sectors in which Living Labs are developing their projects, we will refer to the statistics realized by ENoLL regarding the main sectors of activities. The Figure 8 illustrates the thematic areas in which ENoLL members are active. The first observation we can make from those numbers is the fact that in average, members of the ENoLL network invest in projects that take part in two or three different sectors. Therefore, this confirms the generic nature of Living Labs, enabling them to invest in several sectors of activity. The first and most important sector amongst ENoLL members is the health and wellbeing area. About 52% of Living Labs in the network are developing projects in the healthcare industry, and mainly in solutions addressing social and emotional goals enhancing the quality of life of the ageing population (ENoLL, n.d.).

Figure 8 **Sectorial profiles of Living Labs**



Source: ENoLL official website (www. http://enoll.org)

Then, the next two sectors in which Living Labs are the most invested in are socially oriented. The aim is to improve the social conditions of life in local territories and develop innovative solutions that benefit to the society as a whole on the one hand, and on the other hand to improve social inclusion by setting up concrete actions, such as promoting intercultural awareness and respect, address the issues of homelessness, housing and poverty, but also educate all citizens about their rights (ENoLL, n.d.). Those statistics thus confirm the statements of Pallot et al. (2010) and Picard (2015), arguing that the societal issues, and particularly health, represent a significant sectorial profile of Living Labs.

Then, when we look at different types of Living Labs, such as cross-border Living Labs or Living Labs for sustainable development, we observe that the fields of application are more restricted. In their work, Clermont and Fionda (2016) identified four thematic areas that are subject to potential collaborations and exchanges of know-how in cross-border Living Labs, namely the energy, transport and mobility, healthcare, and creativity and multimedia sectors (Clermont & Fionda, 2016). Those four categories would therefore be a source of synergies in the context of a multinational collaboration. Regarding the Living Labs for sustainable development, Von Geibler et al. (2014) explain that the aim is to shift the users' habits towards more environmentally friendly behaviors. In that view, three main areas of application are concerned; the domains of living and working, region and mobility, and retail and gastronomy (Von Geibler et al., 2014). Those three categories have been selected because of the high

impact the user behavior has in those fields in terms of environmental footprint. On an empirical point of view, several sustainable initiatives have been initiated in Living Labs around Europe, such as the Effizienz-Haus-Plus laboratory in Berlin, which focuses on resource-efficient user of synergies between mobility and housing (Von Geibler et al., 2014). We thus understand that Living Labs are domain-agnostic, but are more applicable in certain sectors when the Living Lab is created for a specific purpose, such as the collaboration between two countries or the development of sustainable solutions. In the next part, we will explore the limits of application of Living Labs in general.

3. Limits of application

In the literature, we discover that there exist actions and programs from Living Labs networks, such as ENoLL, to support the collaboration of stakeholders in the creation of Living Labs. We also notice the strong political support at all levels to enhance this kind of open innovative initiatives (Guzmán et al., 2013). Those observations lead us to raise a question about validity of the projects they finance. Indeed, our main concern would be that the government could finance Living Labs that promote projects in specific fields in which they did not design a viable business model. Kovács (2016) argues that “companies have to foster the creation and sustainability of Living Labs only if they have real economic added value” (Kovács, 2016, p.58). If the government supports a Living Lab through financial aids, the Living Lab could invest in projects in which they would not have the resources to invest in if they did not receive this support. Government’s subsidies could therefore encourage Living Labs to invest in not profitable projects. A concrete example is given by Kovács (2016) with a research made on the attitude and present practice of interactive value production in Austria and Hungary. The main takeaway of this study is the fact that Hungarian companies are not active in interactive value production because of a different innovation culture and a lack of trust and openness of companies. In that sense, the economic value created is not sufficient to sustain Living Labs on the long run, but they are still alive thanks to political financial contributions (Kovács, 2016). Also, an Australian study confirms our doubts by stating that “unsuccessful Living Labs in Spain and France were part of consortia that received initial EU research funding” (Planitz, Hanlen & Suominen, 2013, p.2). We can therefore stay skeptical about the scope of application of Living Labs in Europe and globally given the fact that the government influences the creation of Living Labs in specific fields through subsidies and funding programs.

Another element that limits the scope of Living Labs' applications is the precision of Living Labs' projects. The same Australian study from 2013 showed that the success of Living Labs' projects was closely linked to the precision of their objectives. According to Planitz, Hanlen and Suominen (2013), "all successful labs have well-defined, ongoing projects". They add that "unsuccessful/neutral Living Labs have vague or no project outlines" (Planitz, Hanlen, & Suominen, 2013, p.2). Therefore, it seems essential for Living Labs to focus on precise domains and fields, as well as to build clear and definite objectives. Hence, broad and vague projects seem out of the scope of application to achieve successful and sustainable innovations.

4. Conclusion

In this chapter, we learned that Living Labs can be suited for a various range of applications. More specifically, B2B, B2C and B2B2C projects can be implemented in Living Labs, but those projects should be considered on a medium- to long-term perspective. Also, the typical projects launched in Living Labs seem to fit with the regional interests and to be run mostly with SMEs, as those companies are the ones seeing more important benefits in Living Lab settings. Regarding the sectors of application, we observed that Living Labs are domain-agnostic, but focus mainly on socially-oriented projects and particularly the health sector. We also saw that Living Labs generally invest in two to three sectors. Nevertheless, depending on the Living Lab's objectives, the scope of application will be restricted as it is the case for cross-border Living Labs and Living Labs for sustainable development. In the next chapter, we will rely on the insights we gathered throughout this thesis to understand the contexts the most suitable to the Living Lab by comparing its characteristics to the Fab Lab; a user innovation approach sharing some important similarities with Living Labs.

Chapter 2 – Development of a fit assessment model

In this chapter, we will take the point of view of an enabler coming from the public sector who is willing to invest in innovation in a specific field to enhance the local and regional development. The main objective will be to understand the key differences of application between the Living Lab and the Fab Lab, two approaches that share important similarities, as it has been concluded in the chapter 3 of the part 2. Indeed, they are both focusing on collaboration, co-creation and active participation of users through experimentation and design. Those differences will bring to light the contexts justifying the implementation of a Living Lab, compared to the Fab Lab. To do so, we will first identify the factors that differentiate those two approaches from each other and develop a clear understanding of the elements that are in favor of the Living Lab implementation. Then, we will develop a fit assessment model between Living Labs and Fab Labs. Finally, we will test our decision model empirically in order to evaluate its robustness.

1. Identification of the factors affecting the decision

In this section, we identified 11 elements that distinguish Living Labs from Fab Labs: (1) types of projects and ownership, (2) scope and complexity of the issue, (3) goals definition, (4) communities targeted and user selection, (5) commercialization of a new product, service, business or technology, (6) funding and infrastructure, (7) importance of control, (8) innovation process, (9) role of the manager, (10) observable needs and real-life context, and (11) degree of market uncertainty.

1.1. Types of projects

From many readings, we discovered that the types of projects carried out in Living Labs and in Fab Labs can be significantly different in terms of fields, duration and frequency. Firstly, Fab Labs put a significant focus on numerical and technological projects, which is not the case of Living Labs, who tend to focus on socially-oriented projects. Secondly, it is important to take into consideration the fact that Fab Labs give the opportunity to people to build their own project independently and without any constraint, which is not the case in Living Labs. Therefore, a lot of small projects on the short or medium run tend to be organized in Fab Labs, while Living Labs tend to focus on a unique project on the long run. Indeed, Living Labs rely on multiple research and development methodologies that include a wide range of users in order

to achieve a common goal. Therefore, individual projects on the short run are out of the scope of Living Labs' projects.

1.2. Scope and complexity of the issue

Another element that should be considered when choosing between Living Labs and Fab Labs is the scope and the complexity of the issues we would like to tackle. On the one hand, Living Labs focus on the development of a few number of projects on the long run and a large proportion of their projects concern social, health-related or environmental issues. Those issues are complex and require an intensive investment on the long run, with the participation of expert stakeholders. On the other hand, Fab Labs give the opportunity to any user to develop its own project anytime. Therefore, Fab Labs do not focus on complex and investment-intensive issues where expertise is needed, but they invest in a variety of small projects at the same time and support the users in the co-creation process if they need help, or if they would like to participate in trainings.

1.3. Goals definition

The next aspect that could impact the decision of building a Living Lab or a Fab Lab is the definition of the innovation's objectives. On the one hand, the Living Lab's goals are defined by the group of stakeholders who leads the innovation process and who is at the origin of the Living Lab's creation, namely the enablers, utilizers, providers or users. In that sense, there is one specific goal that is defined by the initiator and pursued by all the stakeholders involved in the ecosystem. Hence, users are selected according to their interests and their engagement towards this common goal. The goal uniqueness is characteristic to the Living Lab approach. On the other hand, the users in Fab Labs are at the origin of the goal they pursue. The users' objective when being involved in a Fab Lab is to initiate their own project in order to find a solution to their specific problem. Therefore, Fab Labs are places where users can initiate multiple goals at the same time, without any selection in terms of the users involved. Thus, contrarily to Living Labs who bring together users with the same needs and goals, Fab Labs welcome users with various needs to develop multiple projects towards different goals. In this scope, the enabler hesitating between investing a Living Lab or a Fab Lab should wonder if his objective is to bring stakeholders together around a unique common goal, or to let users define their own goals.

1.4. Communities targeted and user selection

Then, an essential criterion to take into consideration when choosing between a Living Lab and a Fab Lab is the communities that the project promoter wants to address and the control over the user selection process. In Living Labs, the objective is to select a community of users having the same interests in order to commit them to a specific project on the long run. However, the user commitment is not the only objective when selecting users and Living Labs usually create a testing panel to select an optimal mix of users. Therefore, the community targeted has the same inspirations but include different types of users; expert and non-experts. In contrast, there is no selection done in Fab Labs as they do not try to have control over the users' profiles. However, the public present in Fab Labs has some distinctive features. Indeed, even though Fab Labs are open to everybody, the members could be referred as resourceful technical users, passionate about digital or technology, already knowing about 3D printing and knowing how the machines work. Nevertheless, trainings and workshops are organized to educate regular users in the handling of the different tools.

1.5. Commercialization of a new product, service, business or technology

In our definition, we stated that one of the Living Labs' characteristics is the objective to launch a new product, service, business or technology. This commercial aspect comes from the fact that utilizers represent a group of stakeholders that is necessary to make the ecosystem work properly. As utilizers are often private companies, their objective is to create economic value by developing their own business, launching a new product or service, or adapting an existing product to the market requirements. This commercial aspect is not always present in projects initiated in Fab Labs, as private companies are not necessarily involved in all projects. Indeed, contrarily to Living Labs that form an ecosystem evolving the public, private and people spheres, Fab Labs do not necessitate an active involvement from the four types of stakeholders: enablers, utilizers, providers and users. As the user is the one at the origin of the project idea, he is always present in Living Labs' projects, while enablers provide the infrastructure and providers are present to help the users by sharing their expertise. Therefore, even in the absence of a utilizer, the Fab Lab can work properly without any need to launch the product created on the market at the end of the innovation process.

1.6. Funding and infrastructure

The funding and infrastructure aspect is also an element that could influence the decision of going for one of the two approaches. In Living Labs, the funding is an important issue and, given the important funds required for the development of projects, it represents a challenge for Living Labs to be sustainable on the long run (Guzmán et al., 2013). In contrast, Fab Labs do not invest in intensive infrastructures but simply provide the necessary tools to the users and give them the opportunity to make use of the machines (Diez, 2012). As they do not invest in complex research methods, most of the expenses represent unique fixed costs, such as the building and the machines.

1.7. Importance of control in co-creation

From our understanding of the two concepts, the degree of control is significantly different in Living Labs and in Fab Labs. In Fab Labs, the objective is to give the opportunity to anybody to co-create with the people present in the Fab Lab, but there is no control over their level of interaction or over the final outcome. Thus, an important characteristic of Fab Labs is the freedom in co-creation. Indeed, Fab Labs make tools available and let the participants be independents if they prefer to develop their project alone. We therefore define Fab Labs as places enabling the co-creation process, where there are no requirements or rules. On the contrary, the participation of users in a co-creation process is seen as a condition to be involved in Living Labs. Hence, Living Labs show a higher level of control over the interactions between stakeholders and they orchestrate the co-creation process, while Fab Labs let users interact only if they choose to do so.

1.8. Innovation process

In terms of the innovation process, Living Labs and Fab Labs are once again quite different. On the one hand, Living Labs often use an iterative innovation process, which includes several steps such as planning, concept design, prototype design, innovation design and commercialization of the product or service. This innovation process is therefore complete and involves users from the early steps of the process until the market launch. On the other hand, the innovation process in Fab Labs seems relatively different. In this second type of co-creation initiative, people involved in the Fab Lab can use the tools available only for one part of the development of a product. For example, entrepreneurs can enter the Fab Lab just to create a prototype for the product he would like to launch, without going through

the other steps of the innovation process. Hence, the freedom and openness of the Fab Lab is also represented in the innovation process, which makes it unpredictable, as there is no precise innovation process, in contrast to Living Labs.

1.9. Role of the manager

Lastly, when establishing a Living Lab or a Fab Lab, the role of the person in charge will be quite different. Within a Fab Lab, the role of the person in charge can be seen as an infrastructure manager, as he offers a physical environment where users having access to machines and tools are welcome to come and create. In Living Labs, the role of the manager is quite more complex and can be seen as a relationship manager or an ecosystem manager. Indeed, the manager has to handle the numerous relationships among the different stakeholders and align their incentives.

1.10. Observable needs and real-life context

The eighth differentiating aspect is the opportunity to observe users in their daily environment to understand their needs and habits. If the objective of a project is to optimize the ease of utilization of a new product or service, or adapt an existing product to make their utilization more convenient, it is important to understand how users utilize those products and what their habits are in their daily environment. In order to get some insights about those daily habits, the Living Lab approach is more adapted as it permits the observation of the users' behavior in real-life settings. Those aspects related to observation and real-life contexts are not especially present in Fab Labs.

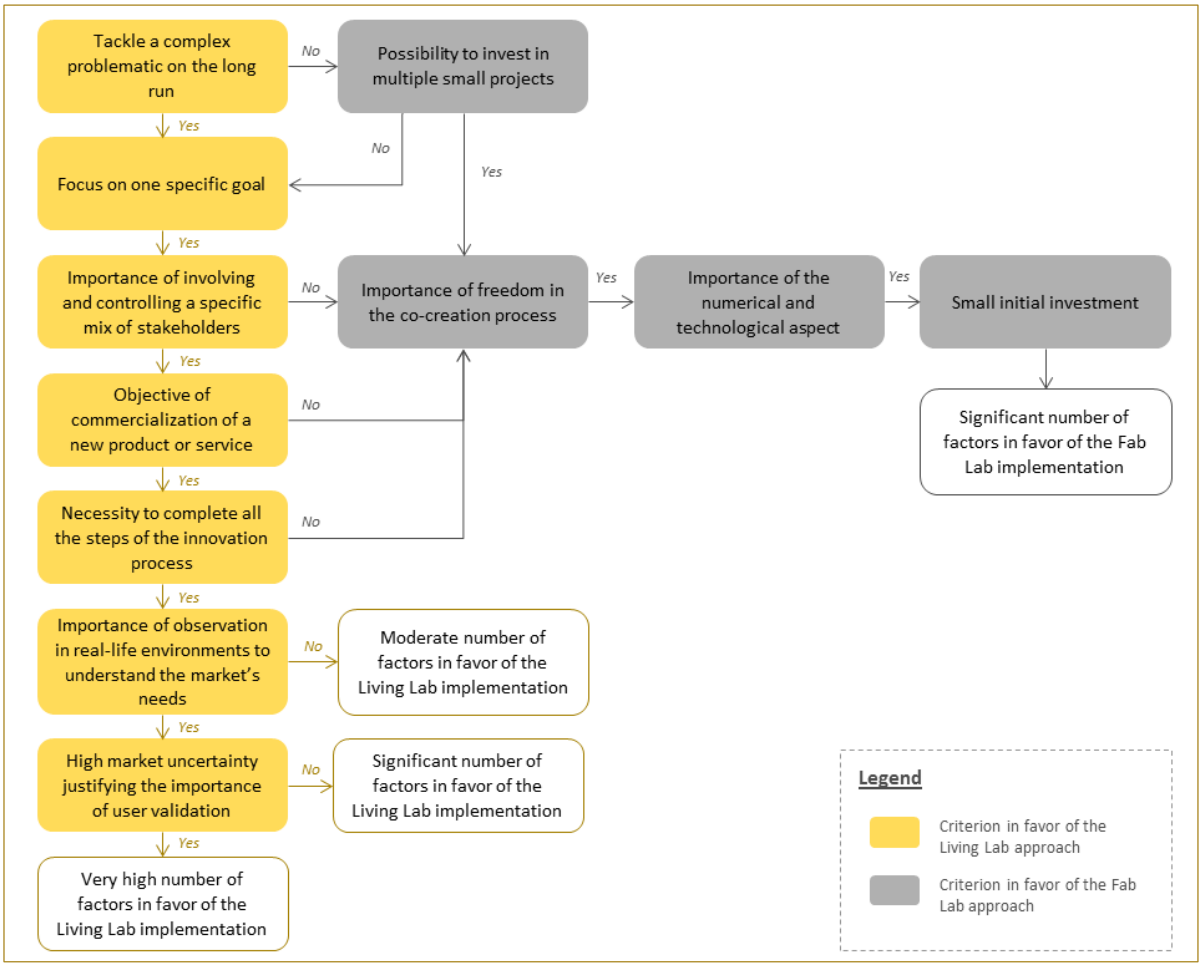
1.11. Degree of market uncertainty

The penultimate differentiating aspect is the degree of market uncertainty. We consider that the market is uncertain if there is some unknown information in the market, such as information in terms of users' needs or habits, which is not available at a certain point of time and could alter the choices made in the development of a product or service. If the market is uncertain, there might be some unexpected behavior from customers when launching a new product or service. By identifying the users' needs in a Living Lab, we increase the knowledge about the market and therefore the probability of market acceptance. The contexts characterized by a high uncertainty will therefore be more adapted to a Living Lab setting.

2. Development of a fit assessment model

Based on the 11 criteria developed in the previous section, we have built a qualitative fit assessment model with the objective of identifying the situations that could suit better the Living Lab approach, compared to the Fab Lab approach. The aim of this model is to help, through a decision-making model between the two approaches, an enabler who is already convinced about adopting a co-creative innovation process through experimentation. The Figure 9 summarizes the key aspects that influence the decision; the criteria highlighted in yellow represent the elements in favor of the Living Lab approach, while the criteria highlighted in grey represent the elements in favor of the Fab Lab approach. However, we deliberately chose not to develop too much the decision tree for the Fab Lab approach, as the main focus of this thesis is on the Living Lab concept.

Figure 9 **Decision model between the Living Lab and the Fab Lab**



According to the fit assessment model, a moderate number of factors in favor of the Living Lab approach would include a focus on a complex problematic to tackle on the long run, a focus on one specific goal, an emphasis on involving and controlling a mix of different stakeholders, an objective of commercialization of a new product or service and a willingness to complete all the steps of the innovation process, from the planning and concept design, until the commercialization. Then, if there also is an accent on observing users in their real-life environments and if this aspect is necessary to understand deeply the market's needs, we can assume that there are a significant number of factors in favor of the Living Lab approach. Lastly, if we go deeper in the analysis and see that the market is characterized by a high uncertainty, we can argue that there are a very high number of factors in favor of the Living Lab approach. In contrast, if the initiative's requirements do not meet those criteria, and are rather characterized by the willingness to invest in multiple small projects, focus on a high level of freedom in the co-creation process, and if the decision-maker would like to invest in numerical and technological projects, but do not have significant financial capabilities, we can consider that the implementation of a Fab Lab is more appropriate. In the next section, we will test this proposed model with the field reality of two entities; Imec iLab.o and Makilab.

3. Empirical verification of the model

In order to check the validity and the relevance of the fit assessment model, we interviewed a Living Lab, Imec iLab.o, and a Fab Lab, Makilab, with the objective of comparing the assumptions made in our model with the field reality. A presentation of those two entities and the empirical testing will be developed hereafter.

3.1. Imec iLab.o

In order to know a little bit more about Imec iLab.o, an interview guide has been established and is available in the Appendix 12, and the transcription of our interview with M. Schuurman is available in the Appendix 14. Located in Ghent, Belgium, Imec iLab.o is a Living Lab that has been established in 2005 and is part of the European Network of Living Labs. Imec iLab.o define itself as "a test and experimentation platform that performs Living Lab research for achieving policy and business goals using stakeholder co-design" (ENoLL, 2017, para. 1). In this scope, Imec iLab.o "offers innovators a representative test user panel of over 10,000 users, a dedicated Living Lab back office platform, business model simulation tools and application prototyping expertise" (ENoLL, 2017, para. 1). We had the great opportunity to

interview M. Schuurman, team leader of the user expertize at Imec iLab.o Living Lab with whom we spent two hours talking about Living Labs operations and discussing the validity of our proposed fit assessment. The complete transcription of the interview is in Appendix 14. Imec iLab.o Living Lab mostly undertakes day-by-day bilateral projects with entrepreneurs in the broad sense, such as start-ups, SMEs, public sector, etc. In that scope, Imec iLab.o Living Lab defines projects along Living Labs methodologies in which end-users are involved in the creation and development of the innovation. Indeed, M. Schuurman highlighted that a key element in a Living Lab, and a fortiori at Imec iLab.o, is the interaction with users through both active involvement and co-creation. Imec iLab.o Living Lab considers itself as a service Living Lab. They tend to work on their own as a division of researchers who offer expertise as a service to the market. In this way, we can consider Imec iLab.o as a provider-driven Living Lab. While the private sector is often part of Living Labs, Imec iLab.o Living Lab runs projects with and for the private sector but it's not part of the organization. The goal of Imec iLab.o Living Lab is to improve innovation by taking into account the aspects, assets, resources of all the different stakeholders being private, users, public and academia research. In practice, Imec iLab.o Living Lab thus focuses more on private sector innovation by collaborating with the other stakeholders. This is confirmed on the ENoLL website presenting Imec iLab.o, where we can find that the objective of Imec iLab.o is "to overcome systemic failures in the innovation process by involving users at an early stage of the development phase, and by creating a trusted environment where small as well as large business stakeholders can meet, and test out innovative products, services and business models" (ENoLL, 2017, para. 3).

Based on our interview with M. Schuurman, we will now test the validity of our model by reviewing the 11 differentiating aspects. The first element that is crucial to test our model is the verification of the types of projects initiated in Living Labs. Based on our model, Living Labs should focus on one unique project on the long run in a variety of fields. From our interview conducted at Imec iLab.o, it appears that all kind of projects can take place in a Living Lab and that Living Labs are domain agnostic. At Imec iLab.o, they are highly invested in day-by-day bilateral projects with entrepreneurs in the broad sense, such as start-ups, SMEs, and entrepreneurs in the public sector. Also, projects are conducted on the long run at Imec iLab.o in order to maintain a sustainable relationship with the different stakeholders involved. The multiple iterations and significant efforts required in terms of resources and time justify this long-term perspective. However, we realized that being involved in one unique project on the

long run in sometimes not possible in practice. As a matter of fact, a big project could be broken down into smaller pieces because of scope and the complexity of the projects; which leads us to our second criteria.

The second element is closely related to the first one and concerns the scope and the complexity of projects launched in Living Labs. As we just saw, the fact that it is not always possible to define a bilateral contract for a whole project because of funding, resources and time issues clearly illustrates the fact that some projects launched in Living Labs tackle complex issues. Also, our interview with M. Schuurman at Imec iLab.o confirmed the fact that Living Labs have the capacity to undertake challenging societal problems, which confirms this aspect of our model.

The following criterion we took into consideration is the user selection and the communities targeted in Living Labs. For its part, Imec iLab.o's goal is to form a user panel composed of different user categories, such as lead users and ordinary users. In that view, they try to create an optimal mix of users collaborating in a joined project towards a common goal. By doing this, they want to maximize the inputs and improve the knowledge exchange between the different stakeholders. They believe that this selection process will create a richer discussion and collaboration than simply selecting a random sample of people. As we can see, this perspective is in line with the criterion we developed and can thus be used in the fit assessment model in order to guide an investor hesitating between building up a Fab Lab or a Living Lab.

Concerning selection of users, Imec iLab.o tries to combine lead user types with ordinary users as well. By doing this, they want to maximize the inputs and thus to have the best possible session. They believe that this process of selection will create a richer session, a richer discussion than simply selecting a random sample of people.

Then, we observed that the next element of our model, namely the commercialization of a new product or service, is also in line with Imec iLab.o's activities. By focusing on projects with entrepreneurs, the commercial aspect is generally present in the projects Imec iLab.o undertakes. However, M. Schuurman brings to light the fact that some projects in Living Labs could have a social purpose, rather than an economic purpose, but he agrees with us saying that utilizers should generally be present in Living Labs in order to make the ecosystem work properly; which therefore involves a private interest seeking for economic benefits.

Concerning the goals definition, M. Schuurman states that the main goal of a Living Lab is to create an ecosystem between the private, public and civic spheres. According to him, creating an ecosystem is done by taking into account the resources and competences of all the different stakeholders. At Imec iLab.o, the focus is more on private sector innovation and in that view; the main goal of the innovation is defined by the entrepreneurs with which Imec iLab.o works. However, the underlying goal pursued by Imec iLab.o is essentially to expand their knowledge and learn from the different projects they carry out. This is done through collaboration with the different stakeholders on the long run and through a learning process which permits the application of know-how gained from their previous projects. Therefore, Imec iLab.o selects projects that are in line with its objectives and thus focuses on one specific goal in collaboration with entrepreneurs in order to generate new knowledge on the long run.

In terms of funding and infrastructure, we observed that Imec iLab.o's resources and activities require a pretty high investment. According to M. Schuurman, the entrepreneurs in the ecosystem pay Imec iLab.o for their services, and this represents the biggest part of Imec iLab.o's funding. In Belgium, every SME can apply for 10,000€ of funding for technology exploration. Part of that money is then transferred to Living Labs in exchange of services. At Imec iLab.o, some people work on European projects and a part of their funding thus come from the European Union supporting Living Labs. To summarize, funding at Imec iLab.o mostly comes from the private sector, which uses the Living Lab's services for commercial project, but also from public sector who subsidize Imec iLab.o's activities. Therefore, Imec iLab.o should offer its services to a sufficient number of entrepreneurs in order to pay the researchers. This is the reason why Imec iLab.o needs multiple projects to be able to fund the people working there. The Imec iLab.o case confirms that funding is an important issue and, given the important funds required for the development of projects, it represents a challenge for Living Labs to be sustainable on the long run.

Then, the importance of control is an important criterion to confront our model to the field reality and our interview with Imec iLab.o totally confirmed our argumentation exposed above. Indeed, a certain level of control is present at Imec iLab.o as there is a Living Lab manager or director responsible of managing the relationships in the Living Lab ecosystem. Therefore, Imec iLab.o defines a clear mission and vision to align the stakeholders' actions and builds a core team that meet quite often to discuss what to do next and how to run the

operations. Hence, Imec iLab.o shows a significant level of control over the interactions between stakeholders and the co-creation process' orchestration.

When it comes to look at the innovation process, Imec iLab.o agreed that in theory, Living Labs can run all the phases of the innovation process from very early ideation towards testing and even implementation. However, it is not always the case in practice for two main reasons. First, as exposed above, it is sometimes not possible to conduct a project from A to Z due to funding issues or because the project takes too much time. Second, it often happens that entrepreneurs come to Living Labs after having done early phases by themselves. At that point, Imec iLab.o argues that they cannot reject those entrepreneurs for the only reason that the Living Lab will not intervene in the whole process; otherwise they would lose a lot of potential and interesting projects. According to M. Schuurman, Living Labs should be open to that kind of projects as well. We can then claim that a Living Lab is a place giving the possibility to run and be assisted through each step of the innovation process, but that going through all the steps of the innovation process is not a strict requirement to enter the Living Lab.

The next criteria that would confirm the implementation of a Living Lab is the observation of users in real-life contexts. Our interview with M. Schuurman confirms this aspect as Imec iLab.o usually tries to get insights on users' daily habits by letting the users interact with the innovation in real-life settings. Concretely, they roll out the innovation and analyze the users' behaviors through several techniques. For example, they developed an application and generated a link so that users could download it and use it on a daily basis. Then, there gathered the users' feedback through surveys and compared the results with logging files to observe what users actually did in the app. A myriad of techniques can be set up, such as following a small set of users, organizing a testing day where users test innovations throughout the day and are observed. It can also be a longer-term implementation, depending on the type of innovation and the different possibilities. Imec iLab.o is currently working on platform where they can do experience sampling measuring. The aim of this technique is to capture the context in which the user is involved by tracking his movements, and trigger questions in order to get insights in real-life contexts.

The penultimate selection criterion is related to the degree of market uncertainty in the market. M. Schuurman agrees with our argumentation saying that Living Labs can be helpful when developing products or services in a market characterized by a high uncertainty.

Indeed, by analyzing and understanding the users' needs, the probability of market acceptance is likely to increase due to the validation of the innovation by a large panel of users. Nevertheless, M. Schuurman highlighted that two kinds of entrepreneurs often come to Imec iLab.o: (1) opportunity entrepreneurs, and (2) lead user entrepreneurs. First, opportunity entrepreneurs are people who spot an opportunity in the market by uncovering a gap in the current offering. These entrepreneurs do not know what would be the best solution for the market and are widely open towards the needs research and the co-creation with users. Therefore, those kinds of entrepreneurs are motivated to come to a Living Lab because of the market uncertainty. However, lead user entrepreneurs are not always in the same vein. As they innovate based on their own needs, they are less interested in needs' identification and co-creation, but rather in market validation and identification of the users' willingness to pay. Therefore, depending on the entrepreneur's type, the motivation related to the market uncertainty can vary. As a conclusion, we can argue that an entrepreneur developing a product in a market characterized by a high uncertainty can find significant advantages in validating his innovation in a Living Lab.

Lastly, the role of the manager in Living Labs has been confirmed by our interview Imec iLab.o as well. Indeed, Imec iLab.o sees Living Labs as a co-creation space, where user involvement and stakeholders' collaboration take place. According to M. Schuurman, the first goal of a Living Lab manager is therefore to facilitate the stakeholder's collaboration and maintain a good relationship between them on the long run. His goal is to align the stakeholders' visions in order to create an outcome accepted by everyone and responding to the initial issue. This last criterion ends our empirical validation with Imec iLab.o and thus completes the test of our theoretical fit assessment model for the Living Lab approach. In the next section, we will present Makilab and the same testing approach will be applied.

3.2. Makilab

For Makilab as well, an interview guide has been established and is available in the Appendix 13, and the transcription of our interview with M. Lomba is available in the Appendix 15. Located in Louvain-la-Neuve, Belgium, Makilab is a Fab Lab that has been established in 2014. Makilab was created by three former civil engineer students from the Université Catholique de Louvain-la-Neuve (UCL) who were interested in the Fab Lab movement and its endless creation possibilities. With the support of the UCL and the Openhub, a creation and

production laboratory located in Louvain-la-Neuve, the Makilab Fab Lab has been built and is now still running thanks to volunteers. The objective of Makilab is to create an environment of collaboration, experience and knowledge exchange by making available several digital machines to a large public. Indeed, 3D printers, laser cutting machines and vinyl cutting machines are gathered at Makilab. No selection occurs to enter the Makilab, everyone is welcome to develop their creations. The idea is to create a physical environment where people can come with a creation project and use the different machines through their innovation process. Volunteers are present to guide and advise the public present but the goal is to let people learn how to use the machines and to create themselves by exchanging with other participants. Moreover, the iterative process is facilitated at Makilab due to the affordable fabrication and the availability of the machines; it is therefore possible to let the participants learn by themselves through iteration. As mentioned, there is no target public. Hence, students, private individuals as well as start-ups and SMEs come to Makilab with diverse objectives but always with the will to create something. For example, start-ups are using the Makilab to develop prototypes of products destined to be launched on the market while architecture students are utilizing the Makilab opportunity to build architectural model in the scope of their study. The only condition to enter the Makilab is the purchase of a membership license fee including an initiative formation for the machines' utilization.

By reiterating the same verification process for Makilab, we will start here with the identification of the types of projects initiated in Fab Labs. Our interview with Makilab validated the fact that Fab Labs give the opportunity to anybody to build its own project independently and without any constraint. Therefore, there exist a myriad of small projects in development at Makilab. In terms of the fields concerned, Makilab states that their Fab Lab is essentially about numerical fabrication, with a technology focus. Nevertheless, they precise that the focus of the activities performed in Fab Labs usually depends on the organism supporting the Fab Lab. Here, Makilab is supported by the Université Catholique de Louvain, which influences the projects towards a technology focus. Concerning the ownership issue, they do not intend to create any specific agreement on intellectual property rights. As their Fab Lab shares a communitarian culture, they believe that users participating in Fab Labs are open and share their ideas with others, while their creation is their own property.

Concerning the scope and complexity of the projects, Makilab confirmed us that the majority of the projects taking place in Fab Labs are realized on a short and medium run perspective. According to them, there exist mainly three types of projects: (1) individual projects on the short run, (2) group projects on the medium run, and (3) projects realized in a partnership with other organisms. For the first category, individual users come to the Fab Lab four to five times in average in order to build their project, and then they bring their creation back home. For the second category, group projects are often launched in order to bring people together around a more complex problem on the medium term. For example, they are currently organizing a robot project, starting from scratch, with the objective to think about new technological solutions. The third category includes co-creative projects realized in a partnership with outside organisms, such as the Open Hub. Those kinds of projects are also developed on a short or medium term perspective. To conclude, Makilab confirmed us that their laboratory is mainly about small scale projects, and that they do not tackle complex environmental or societal issues, which is the case in Living Labs.

The next criterion taken into consideration is the communities targeted and the selection of users. Makilab informed us that there is no target audience, even though they mainly have two types of participants coming to the Fab Lab: (1) students in electromechanical or architecture, and (2) start-ups and SMEs. Firstly, the students coming to the Fab Lab are regular members and already know how to use the machines. Secondly, they help the start-ups to concretize their idea into a prototype in order to validate a concept. Therefore, communities participating at Makilab could be referred as a niche group as they already have a specific knowledge in technology and know how to use the different machines and tools. Also, there is no participant selection in the Makilab; everybody is welcome and the goal is not to create a specific group of users. The fact that co-creation is possible and encouraged but not required within Fab Labs induces this disinterest regarding the establishment of an optimal mix of users.

The fourth aspect that verifies our model is the commercialization, which is not necessarily present in Fab Labs. At Makilab, the collaboration between private companies and users is not a requirement. They often welcome start-ups in their laboratory, with an objective of commercialization, but a significant proportion of projects do not involve that dimension.

Then, Makilab states that the users are at the origin of the goals in Fab Labs, which results into a variety of goals that depend on the users' needs. Hence, as there are multiple divergent needs, there are a wide range of different goals as well. Therefore, there exist two main types of goals: (1) individual goals, and (2) common goals. The individual goals are reflected in small projects on the short run, while common goals are reflected in group projects, such as the robot project. It has to be highlighted that Fab Labs goals remain concrete tangible goals.

Concerning funding and infrastructures, Makilab emphasizes on the fact that they need a high flexibility to initiate and develop a Fab Lab. As a matter of fact, Makilab's founders did not invest a lot of money in their infrastructure, but obtained their machines through multiple funding sources. For example, they got a second-handed vinyl cutter, they funded their laser cutter through crowdfunding, and they got their 3D printer offered from a distributor. In terms of the building, their partnership with the Université Catholique de Louvain permitted them to get a room and some instructors paid by the university. Therefore, most of their fixed costs are covered without any heavy investment. Concerning the variable costs, they do not invest in specific research methodologies and the costs of fabrication at Makilab are quite low. Nevertheless, users participating in the Fab Lab pay a reasonable membership fee and the extra material they need to build their project. In terms of the infrastructure, they have joining techniques and electro mechanics, but they have a limited potential for heavy projects. Hence, we can conclude that this Fab Lab is characterized by small investments and a basic infrastructure.

Another important aspect is the level of freedom in the co-creation process in Fab Labs. Following our interview with Makilab, the main takeaway is their objective of teaching people how to build a project themselves. In their laboratory, they share the "learning by doing" spirit and they do not pay attention to the motive of the people who come to the Fab Lab. Their role is not to guide or influence the outcome, but essentially to share their technical knowledge and promote the iterative creation process. Therefore, there are no rules, except the implicit attitude of being respectful and honest. In that view, we clearly understand that nobody controls or guides the co-creation process, as the freedom is strongly promoted. In particular, in the robot project, the project leader could disagree with the others' ideas, but it is not in the culture to impose a specific opinion. Also, through their collaboration with

external organisms, they form a favorable place for the development of co-creative processes, but there is no obligation to participate. In short, if people are not willing to be involved in co-creation initiatives, they can just develop their project independently.

In terms of the innovation process, Makilab does not impose any methodology or process to the participants. The Fab Lab is rather a place that provides the opportunity to go through several steps of the innovation process, from the concept design to the prototyping phase, but once again there are no rules. Concerning the methods used, the informal aspect of the innovation process induces the fact that no formal methodologies are used, and that not all the steps are necessarily completed. Hence, the innovation process is often characterized by iterative tests that go along with the "learning by doing" spirit. In that view, the participants can be involved in the Fab Lab just for one or two steps of the innovation process. As concrete example, start-ups are often involved in the Makilab in order to take part in pre- prototyping, prototyping, or new value proposition activities. Their objective is generally to materialize their idea into a prototype and validate their concept to present them to an investor, but not to design the whole concept in the Fab Lab. On the other hand, group projects often go through all the steps of the innovation process, such as the robot project. However, Makilab underlined that Fab Labs are not suited for the implementation process.

Lastly, the role of the manager in Fab Labs has been confirmed by our interview Makilab as well. Makilab specified that their role was not to organize and manage the projects initiated by the participants or the co-creation process. As a matter of fact, they manage the Fab Lab's opening hours to welcome different types of publics and they outsource the Fab Lab for external projects with other organisms, such as the Open Hub. Therefore, their mission is to create a favorable context to welcome different types of projects and manage the infrastructure. This last criterion is in line with our argumentation, stating that the role of a manager in Fab Labs is to be an asset manager.

Following our model, as all the criteria above are in accordance with Makilab, we can already state that our model confirms the application of the Fab Lab approach. Nevertheless, we will go through the next two criteria in order to validate the differentiation made in the section 2 of this chapter. Following our model, the importance of observable needs in real-life environments and the degree of market uncertainty are two elements that are especially relevant for the Living Lab approach. Therefore, they should not be a priority at Makilab.

Concerning the observation in real-life environments, it is not an element that is considered as important at Makilab. According to Makilab's instructors, they do not try to understand the users' needs, but they just support them in the creation of their project. When they observe the utilization made of the machines, it is simply because they are curious about the varied possible outcomes. Therefore, they only observe the users to share their point of view or their technical expertise. Unfortunately, the market uncertainty cannot be analyzed in the Makilab case, given the fact that there is not a commercialization purpose in a particular market. As a conclusion, we can state that this empirical test with Makilab verifies the applicability of our model for this particular case.

3.3. Confirmation and disclaimer

Through the empiric cases analyzed, it appears that the fit assessment model proposed can serve as a relevant tool in order to guide an enabler in the establishment of a Living Lab or a Fab Lab in order to understand the best contexts suitable for implementation. An emphasis has to be set on the fact that the model presented above needs a larger recognition. A panel of organizations should be confronted to the model to increase its robustness and hence confirm its validity of use. The fact that one Living Lab and one Fab Lab were involved in the model creation do not allow for a broad recognition of the model and further research is thus required.

Conclusion

In this part, we identified the main fields and contexts favorable to the Living Lab implementation and we can conclude that Living Labs are domain-agnostic and thus represent an appropriate tool for regional projects in a variety of fields. Nevertheless, compared to Fab Labs, Living Labs are more adapted to complex projects related to social, health-related or environmental issues. Also, the contexts requiring the addressment of a unique common goal on the long term in the perspective of commercializing a new product, service, business or technology are considered as the most suitable for the initiation of projects in Living Labs. This goes along with markets characterized by a high degree of uncertainty, where users' needs are not predictable and where users can contribute significantly by providing their tacit knowledge.

Part 5 – Management implications

This last part will focus on the main implications for the Living Lab manager and the different stakeholders taking part in the Living Lab's projects. The objective will be to understand the main benefits and drawbacks in terms of innovation outcomes, resources and investments, the benefits for each group of stakeholders, as well as the actions and practices that drive the success of Living Labs, compared to the ones that put its sustainability at risk. This part is thus divided into two chapters; the first one will explore the literature on Living Labs to understand the main advantages and disadvantages, and the second one will identify the key success factors and propose a brief risk assessment.

Chapter 1 - Advantages and disadvantages of Living Labs

1. Advantages in terms of innovation outcomes

When we look at the opinion of the Living Lab's practitioners, we firstly observe that there is a consensus regarding the positive impact of active user collaboration in the innovation process (Santoro & Conte, 2009; Pallot, 2013; Seys et al., 2013; Leminen, 2015; Clermont & Fionda, 2016). Indeed, the early integration of users improves the detection of new and emerging behaviors and user patterns, and permits an early assessment of the socio-economic implications regarding the new product or service (Santoro & Conte, 2009). The users not only propose ideas and participate in the product or service development to create new business opportunities, but they also provide a concrete feedback on the prototypes and provide a different perspective to the researchers. In that sense, Clermont and Fionda (2016) state that "the products and services under experimentation are validated and enriched through testing by the characteristics defined by the final users" (Clermont & Fionda, 2016, p.36).

Concerning the iterative processes in Living Labs, the user feedback is taken into account at each phase of the product or service development and those iterations with the different stakeholders permit to achieve product-market fit without spending a lot of resources (Seys et al., 2013). As a result, the design process is improved thanks to a reliable evaluation of the market needs, while the time-to-market decreases (Feurstein et al., 2008).

Thirdly, the market demand is stimulated by the user involvement even before the market launch. This aspect encourages a higher probability of market acceptance, as the

developers are aware of the users' expressed and unexpressed needs at the early stage of the product or service development (Seys et al., 2013). Indeed, Eriksson et al. (2005) also highlight that "involving a large number of end-users already in the technology innovation phase is expected to boost the societal impact of the achieved technical breakthrough, in terms of both broad utilization and delivered value" (Eriksson et al., 2005, p.10).

Then, as Living Labs engage different types of stakeholders in the innovation process, the active dialogue and collaboration between those key actors facilitate synergies of ideas and capabilities to support the development of new product and services (Guzmán et al., 2013). Building a community between the different stakeholders can therefore increase the research results as long as the Living Lab encourages a sufficient level of user commitment (Seys et al., 2013). Moreover, the Living Lab covers different social and cultural systems cross-regionally and is therefore a good basis for rapid and global mass customization (Eriksson et al., 2005).

Also, a Living Lab ecosystem aims to tackle complex real-life problems by integrating a multi-contextual sphere that immerses the end-users in a real-life context. Hence, the researchers can interact with users in this multi-contextual sphere and access real interaction data in real application contexts and hence determine the most accurate user behavior in a daily life context (Leminen, 2015). Von Geibler et al. (2014) emphasize on the reasons behind innovations failures. According to them, many innovations fail because of low user acceptance or because of negative rebound effects due to unexpected user behavior, which reflects a problem of technical adaptation to the real life and work environments of users. Therefore, as Living Labs observe the interactions between people and technologies in real-world utilization contexts, they optimize the product or service adaptation to the real-life before launching the product (Von Geibler et al., 2014).

Finally, the combination of different research methods in Living Labs permits to take advantage of the strengths of each research method while compensating for its limitations: "this provides a more in-depth insight in the wants and needs of a user and provides a broader contextualization of the user research" (Seys et al., 2013, p.3). If we look deeper at the different methodologies used in Living Labs, we observe that panel-based techniques allow gaining deeper insights in the profiles of users, such as lead users, defectors, etc. The developers can therefore get a broader view of the market needs by combining the different

datasets (Seys et al., 2013). Furthermore, the details about each profile goes along with an optimization of the stakeholders' diversity, which ultimately increases the value of their input in the development process.

In this section, we gathered interesting insights about the advantages of Living Labs in terms of innovation outcomes. A list of all those advantages is provided in the Appendix 6. We can easily observe that those advantages are directly linked to the features of the Living Lab concept, such as the user involvement, the iterative innovation process, the involvement of different stakeholders, the development in real-life settings and the combination of various research methods. In the next section, an overview of the advantages in terms of risks, resources and investments will be developed based on the Living Lab literature.

2. Advantages in terms of risks, resources and investments

In terms of the development process, Feurstein et al. (2008) state that Living Labs reduce the risks related to the development of new products and services. The author argues that developments mainly based on technological possibilities often result in a low rate of successful and sustainable innovative products in the market. Thus, by evolving users in the process as of the early stages of development, Living Labs can better identify their needs and optimize the allocation of its resources in products that have a higher probability to be launched in the market (Feurstein et al., 2008). Consequently, it is possible to decrease the amount of investments in products that won't reach the market at an early stage of the product development. This reduction of costs is "particularly attractive to SMEs, micro-organizations and start-ups, who typically have problems acquiring sufficient venture capital" (Feurstein et al., 2008, p.2). Regarding the diversity of stakeholders, a community of different profiles in a Living Lab permits resource-sharing capabilities that will reduce the technology and business risks related to the development process (Van der Walt et al., 2009). Moreover, a Living Lab reduces the duplication of efforts by bringing together the different actors in order to make a better use of individual investments. Indeed, "double investments into similar research infrastructure can be avoided and centers of excellence for specific sectors or technologies can be established within Living Labs" (Feurstein et al., 2008, p.7). Finally, if we look deeper at benefits provided from the user involvement in the development process, Leminen et al. (2012) emphasize on the fact that user-centered researches help alleviate the risk involved when launching a new product or service. All those advantages are summarized

in the Appendix 7. In the next section, we will explore the benefits for the different stakeholders.

3. Advantages for the different stakeholders

We previously talked about the advantages of user involvement, but we did not approach yet the motivation of those users to take part in this kind of initiative. Santoro and Conte (2009) highlight the empowerment to influence the development of product and services that would answer specific needs that the current product and services in the market do not meet. By participating actively in the development process, the users could contribute to savings and improve the innovation process to develop a product or a service that would not be achievable without their contribution (Santoro & Conte, 2009). Leminen (2015) add that the developed solutions can solve "problems that affect their everyday lives and which may have been otherwise unsolvable" (Leminen, 2015, p.3) if the users did not take part in the innovation process. The solutions derived from a co-creation process are also perceived to be more functional according to the users (Leminen, 2015).

Regarding the interests that companies gain in interacting with a Living Lab, SMEs can take part in a Living Lab to develop, validate and integrate new ideas and quickly expand their local offering in new markets (Santoro & Conte, 2009). Also, by partnering with users and other companies, larger companies increase the effectiveness of their innovation process, reduce the development cycles and develop a product or service that is "right the first time" thanks to the active user involvement (Santoro & Conte, 2009). This open cooperation benefits both SMEs and larger companies, as they get a cost-efficient access to end-user data and user experiences. Indeed, thanks to this valuable information, they are able to make changes to a product or service at the early steps of the development process based on the user feedback (Leminen, 2015). Feurstein et al. (2008) also stress the advantage of getting access to state-of-the-art technologies that could be delivered through different business models. Furthermore, on a long-term perspective, Living Labs create a connection between customers and the companies involved, which increase the brand recognition and the customer loyalty (Leminen, 2015).

Through Living Labs, researchers and developers have the ability to foster new hypothesis and research scenarios via an inductive approach of idea generation. They also get a privileged access to communities in a real-life context and get access to new methods that

allow for a valorization of their results (Dubé et al., 2014). According to Santoro and Conte (2009), this approach could also bring new opportunities and resources to the researchers and developers, while increasing their returns on investment.

The aim of public agencies is to create value through experimentation in order to justify the investments made. Santoro and Conte (2009) highlight several aspects that increase the value of innovation through a Living Lab for the society, such as delivering common processes for validating market offer, harmonizing national and regional initiatives in a specific field, optimizing investments in the targeted market, create new market demand, etc. They also mention the advantages of adopting common business taxonomy for launching new technologies, attracting further investments to invest in a particular domain and also involving SMEs in collaboration initiatives to make them access new competences and technologies on a global scale (Santoro & Conte, 2009). In addition, Living Labs initiate a dialogue between citizens and the government, which stimulates the creation of value chains that have a positive social and economic impact in a regional context (Dubé et al., 2014). Also, public agencies can use Living Labs to improve the public sector operations from a content and application perspective (Feurstein et al., 2008).

Concerning the universities and specialists, their main goal is to drive research and knowledge forward in a specific domain. By being involved in a Living Lab, they can foster interdisciplinary research and position themselves as a pioneer in experimentation in a particular field (Dubé et al., 2014). A Living Lab driven by a university will focus more on academic projects aiming for knowledge creation, while a Living Lab driven by private companies will mostly serve economic interests (Dubé et al., 2014).

Finally, according to Dubé et al. (2014), investors are encouraged to invest in Living Lab's activities for several reasons: they can better evaluate the technological risk regarding the product development and, as the research and development process is more efficient, the time-to-market is reduced and the market acceptance probability is increased. Moreover, the diversification of usages of the same technology increases the presence of the new technology in several markets and ultimately increases the return on investment (Dubé et al., 2014). The Appendix 8 summarizes all the advantages of being involved in a Living Lab for each stakeholder category. In addition, the Appendices 9 and 10 explore some additional considerations related to corporate social responsibility and networks of Living Labs. In the

next section, we will explore the disadvantages and the challenges linked to the Living Lab concept.

4. Disadvantages and challenges

We already mentioned in this thesis that there is a need to involve a high number of users in the development process of Living Labs. However, a main drawback of the Living Lab approach is the fact that this involvement requires a lot of efforts from the users (Seys et al., 2013). Indeed, Guzmán et al. (2013) argue that "the effectiveness of a living lab depends on the involvement of lead users and a relevant set of early adopters in the innovation process" (Guzmán et al., 2013, p.38), which implies that innovation initiatives could fail if they do not involve the appropriate participants in terms of profile and scale. In that sense, the product or service could simply be unfinished or not meet an appropriate target market (Guzmán et al., 2013). Furthermore, the Living Lab could face some challenges when trying to involve users who are not used to give feedback (Seys et al., 2013). Hence, it is essential to stimulate the participation of different stakeholders and especially users. Passion for the product or service to be developed and recognition to other users generally guarantee the motivation of the participants to get involved in a project, and in the longer term, at the level of Living Lab. Feurstein et al. (2008) report that specific methods and business models are needed to stimulate individual users to participate. Intrinsic or non-intrinsic rewards have to be implemented as well as an incentive mechanism to secure pay-back to all the actors involved (Feurstein et al., 2008).

Concerning the identification of market needs, Clermont and Fionda (2016) highlight the difficulty to identify the public emerging needs that constitute a proper mix between innovation and commercialization. According to them, they have to be "sufficiently distant from the marketplace so that they require research and development in order to achieve an innovative solution" (Clermont & Fionda, 2016, p.43), but also not too far from the market, otherwise there would be a high risk of not being able to satisfy those needs with a product or service. Indeed, this could lead to a high pressure on companies that are not able to find a solution that meets the expectations of users within the limited duration of the contract (Clermont & Fionda, 2016). Also, there is a significant complexity to document the experimentations and their results. Indeed, most Living Labs acquire subjective information from which it can be difficult to extract an added-value for the product or service development

(Dubé et al., 2014). As a consequence, it remains difficult to translate the findings and the users' feedback in actionable results (Seys et al., 2013).

In terms of risks and benefits sharing between private companies and public agencies, Clermont and Fionda (2016) mention the problematic conflict of interests that can arise between those two parties. They precise that a great attention should be paid to the intellectual property rights resulting from the innovation process. The authors learned from their experience that there is a high risk of disputes if this issue is addressed at the end of the contract implementation (Clermont & Fionda, 2016). Adopting fair and suitable mechanisms for the handling of intellectual property rights and other ethical issues is therefore a problematic that Living Labs should overcome at an early stage of the product and service development (Feurstein et al., 2008).

As regard to the resources and investments needed to set up a Living Lab, Guzmán et al. (2013) bring to light the intensive long-term funding necessary to create a Living Lab. They stipulate that this kind of investments may necessitate non-traditional models to fund innovation. The authors add that there is a "lack of dedicated personnel who have the required competencies and skills to manage living lab innovation projects and initiatives" (Guzmán et al., 2013, p.38). Moreover, other studies show that the creation of Living Labs is highly time-consuming (Seys et al., 2013). All those elements increase the challenges in terms of resources and investments for the setting up of a Living Lab.

After having reviewed the main advantages, disadvantages and challenges, the next section will gather the main findings into a SWOT analysis and briefly observe how Living Labs can take advantage of the opportunities and overcome the challenges they face by relying on their main strengths.

5. Construction of a SWOT analysis

In this section, the Table 8 represents a SWOT analysis that summarizes the takeaways of this chapter.

Table 8 - SWOT analysis

Strengths	**Weaknesses**
User involvement in the development process Co-creation Iterative process Diversity of stakeholders Real-life settings Multi-methods Resources optimization Cost-efficiency Reduced risk in development and market launch Sustainable approach	Difficulty to motivate users Difficulty to identify the needs that represent a proper mix between innovation and commercialization Problem of translating the findings in actionable results Time-consuming setting up Intensive long term funding
Opportunities	**Threats**
Willingness of users to influence the development of innovations Continuously evolving needs Willingness of companies to get a cost-efficient access to end-user data and reduce the development cycles	Users who are not used to give feedback Conflict of interests between private companies and public agencies Issue of intellectual property rights No uniformed practices for Living Labs Heterogeneous political goals amongst regions

Opportunity for researchers and specialists to develop new knowledge and methodologies Call for a dialogue between citizens and the government Presence of public subsidies for innovations Possibility to be part of the ENoLL network	

From the Table 8, we observe that the main opportunities rely in the interests and expectations of the different stakeholders. As each stakeholder group can find a value in collaborating with another stakeholder group in the Living Lab ecosystem, the Living Lab manager can orchestrate the relationships between the stakeholders in order to extract the most value out of the collaboration process. This illustrates the importance of selecting a competent Living Lab manager, who could also be a good intermediary to moderate the potential conflicts of interests between private companies and public agencies and to deal with the issues of intellectual property rights at the beginning of the collaboration. Also, given the difficulty to motivate users and the challenge that some users are not used to participate in an innovation process, it seems important to propose support activities and services to the end-users in order to motivate them and make them understand clearly how the process works. This can help overcoming those challenges by making them feel involved and motivated throughout the whole process. In addition, we observe that the high requirements in terms of funding can be partly addressed by the help of public agencies. This SWOT analysis highlighted some interesting considerations for the management of Living Labs, but in order to understand the key actions needed to obtain successful results from the Living Lab's activities, we will identify the main key success factors and carry out a quick assessment of the risks regarding Living Labs in the next chapter.

Chapter 2 - Key success factors and risk assessment

In this chapter, we are going to highlight the elements that design the success of Living Lab initiatives and spot the main risks associated with Living Labs by exploring the literature.

1. Key success factors to implement and manage a Living Lab

The first aspect that is highlighted in the literature (Veeckman et al., 2013; Guzmán et al., 2013; Seys et al., 2013; Leminen, Westerlund & Nystöm, 2014) concerns the user involvement and the development of a community. Even though all Living Labs interact with users in their daily activities, Veeckman et al. (2013) argue that in practice, there exist very different levels of interaction. The authors highlight the importance of having a minimum set of users and say that the level of engagement of users has an impact on their involvement in the Living Lab's projects. This shows the importance of building a community of users to enhance the level of user involvement in Living Labs. However, the type of community matters; depending on the type of community the Living Lab builds, the level of user involvement will be impacted (Veeckman et al., 2013). The authors explain the difference between a "community of interest" and a "community of practice". A community of interest is represented by a group of users who share the same interests and passion. Thus, they will exchange their ideas and share their opinions about a certain topic. A community of practice connects people informally through what they do together and what they have learned through their mutual engagement in specific activities (Veeckman et al., 2013). It is therefore essential to discover what drives the users in order to foster the creation of a strong community. Subsequently, it will be possible to define key interest areas and innovation initiatives collaboratively with users, designers and researchers (Guzmán et al., 2013). The stronger the collaboration and the feeling to belong to a community, the more engaged and involved the users will be in the Living Lab's activities on the long run. Another aspect that will reinforce the positive impact of user involvement and the innovation outcomes is the type of users involved as well as the role they have in the product or service development. Seys et al. (2013) identify two main types of users; the "alpha users" and the "new users". Alpha users participate in a lot of research projects without being experts in all innovation fields. They know how the research methods and innovation process work and they are able to in-depth feedback on the innovation. New users have less experience in research programs and innovation processes, and they are sometimes not used to provide feedbacks. However, the

authors mention that there exist several sub-categories of user types, such as lead users, defectors, etc. and it is possible to gain deeper insights in the profiles of users through a panel-based approach. According to the authors, a mix between alpha and new users seems to be ideal to get a valuable feedback on innovations, as well as an optimal mix between the users profiles (Seys et al., 2013). Concerning the role of users, Leminen, Westerlund, and Nystöm (2014) propose a typology of four use roles in Living Labs: informant, tester, contributor, and co-creator. Again, it is important to involve an optimal mix of users with different roles at each step of the product or service development. For example, Veeckman et al. (2013) state that test users must be involved in the different phases of the innovation cycle in order to test the porotypes and give a positive or negative assessment of the innovation through surveys or in-depth interviews.

Concerning the long-term participation of users in the Living Lab, Veeckman et al. (2013) highlight the importance of trust and good communication to keep users motivated. Von Geibler et al. (2014) also argue that the relationship with users should be at the center-stage of Living Labs. They advise the inclusion of a moderator who can foster trust and understanding between users and researchers (Von Geibler et al., 2014). Several methods can be used to motivate users and foster their commitment. According to Feurstein et al. (2008), intrinsic or non-intrinsic rewards have to be implemented as well as an incentive mechanism to secure payback to all the actors involved. Clermont and Fionda (2016) suggest providing users with gadgets or symbolic prizes for the best feedback, remarks and suggestions that improve the tested prototype. Then, in order to foster the commitment of users in the co-creation process, Dubé et al. (2014) recommend to plan and conduct activities driven by the intended result. During the planning phase, a forum for discussion should be organized to call for the opinion of each user in the project. During the conception phase, it is crucial to create relationship of trust with users through a series of workshops. In the more advanced phases of the project, the co-creation is mostly driven by the experiences of users with the prototypes in development (Dubé et al., 2014). Those activities go along with services that should be offered to users to improve the relationship and the convenience for users. According to Mulder et al. (2007), Living Labs should “offer a mechanism for the integration of the customers’ product or service into a Living Lab to provide it to the users” (Mulder et al., 2007, p.7). Indeed, a transparent and smooth integration is key for trust and convenience (Mulder et al., 2007). Then, co-creation should be facilitated through the methods that are the most

suitable according to the users' needs. For example, according to the development phase, traditional market research methods or internet-based methods can be used to facilitate the co-creation process. A third service that should be offered to users in Living Labs is the standardization of data preparation. According to Mulder et al. (2007), this "permits to fulfil their expectations regarding the results of the researches and to reduce the complexity of data" (Mulder et al., 2007, p.7).

When it comes to involve different stakeholders in the innovation process, research organizations, users, universities, companies and other stakeholders need to interact in the development process to enhance the Living Lab ecosystem. Eriksson et al. (2005) suggest open collaboration between people of different backgrounds, with different perspectives that have different knowledge and experiences in order to stimulate creativity and generate new ideas bringing value through use. Veeckman et al. (2013) show the importance of creating value to attract and retain members, but also to share the created value within the ecosystem. In other words, each stakeholder should find an added value in the project in order to engage the Living Lab's activities. Veeckman et al. (2013) add that having a minimum of shared value creation among all stakeholders is of strategic importance to shape the ecosystem. In that view, two elements are recommended: (1) a clear thematic focus, and (2) a mix of various stakeholders. Veeckman et al. (2013) argue that "a clear thematic focus will lead to complementary, shared motives for collaboration within the Living Lab" (Veeckman et al., 2013, p.16), which will in return increase the engagement towards a given topic. Also, a mixed and large set of stakeholders will increase the number of opportunities by complementing the value chain within the Living Lab (Veeckman et al., 2013). However, building such an ecosystem is only possible through a minimum level of openness of the innovation process. This concept is related to the management of intellectual property rights as well as the integration of stakeholders. Veeckman et al. (2013) argue that there should be a sufficient level of knowledge sharing, shared interests and partnership creation to enable a good collaboration within the ecosystem. If there is a lack of openness in intellectual property rights and partnerships, it can be tremendously difficult to build up a good ecosystem (Veeckman et al., 2013).

Regarding the Living Lab's projects, an Australian study showed that "all successful labs have well-defined, ongoing projects" (Planitz, Hanlen & Suominen, 2013, p.2). In that view, it

is important for Living Labs to build clear objectives and focus on precise and well-defined projects in order to maximize the probability of success of their activities. The second element that goes along with the definition of projects is the development of a strong project portfolio. Dubé et al. (2014) argue that a project portfolio with multiple applications, such as commercial, academic and social applications, is important to secure the Living Lab's sustainability on the long run. Such a project portfolio can be built through the development of transversal competences within the Living Lab, in order to enhance the synergies between projects (Dubé et al., 2014). Also, relying on pilot projects and fast prototyping permits to bring together the different stakeholders around concrete projects and it enhances a fast value creation in the Living Lab (Dubé et al., 2014).

In terms of the processes and tools used in Living Labs, Mulder et al. (2007) argue that it is an essential aspect when creating usable systems in order to enhance the involvement of users throughout the development phases. The importance of having a mixed set of methods and tools available in Living Labs is also highlighted in the literature. Veeckman et al. (2013) mention the relation of dependency between, the type and mix of tools and the possibility to discover new opportunities. Concerning the different methods, Veeckman et al. (2013) bring to light the advantages of using participatory methods to enhance co-creation, as well as using ethnographic tools to influence usage behavior. Also, the grid technology is a useful tool to enable scalability in Living Labs. According to Mulder et al. (2007), given the high volume of data generated within the Living Lab, new analysis and reporting modules are needed as it is not always clear a priori which data is relevant. They also mention the importance of scalable, flexible storage and computing resources to cope with large amount of data (Mulder et al., 2007). Furthermore, experts have the opinion that developers should benefit from a minimum level of freedom to develop their creativity and get the opportunity to take risks (Von Geibler et al., 2014). The process should therefore stay sufficiently flexible and adaptable to permit the emergence of new methods and tools. Von Geibler et al. (2014) also propose to establish an evaluation framework that works in proximity to the process in order to support solutions that exhibit the most promising development patterns.

When it comes to the technical infrastructure and the technologies used, Veeckman et al. (2013) argue that an appropriate technical infrastructure should be available for the test users within the Living Lab when assessing or co-creating innovations. Guzmán et al. (2013)

add that a well-defined infrastructure should be set up to manage each step of the process, enhance user innovation and allow companies to integrate it to their innovation strategies. For monitoring purposes, a Living Lab should have a technical testing as part of the research and design activities of a project. For example, when opting for a fixed infrastructure, the Living Lab will have a clearer focus on the types of projects launched and it will facilitate contextual research compared to ad-hoc infrastructures (Veeckman et al., 2013). It is also important to consider the implementation of technological and ITC systems to facilitate the innovation process and support interaction and communication (Mulder et al., 2007). Guzmán et al. (2013) add that physical resources, software tools and a dedicated personal is also required to be effective through all the steps of the innovation process.

Then, regarding the strategic and operational decisions in Living Labs, Mulder et al. (2007) explain that the strategic market position of the Living Lab should be defined, while the management should be structured and include specific roles, such as a director, a steering board, a technical program committee and a user committee. The way intellectual property rights are handled, the degree of flexibility and scalability of the Living Lab and the way stakeholders are involved should also be clearly defined. Another important issue is the funding strategy and the Living Labs' drivers, which can be related to community, research, industry or technology purposes. Also, the ownership questions and the level of openness are important considerations as well (Mulder et al., 2007). On an operational point of view, the authors show the importance of shaping the day-to-day management, as well as the execution and monitoring of the Living Lab's goals. In that view, working practices, internal communication and progress monitoring should be in line with the Living Lab's strategic objectives. The authors add that the introduction of new software and services should induce the definition of responsibilities and liabilities in the Living Lab (Mulder et al., 2007).

Concerning the funding system, given the high share of basic research that needs to be conducted within Living Labs, Von Geibler et al. (2014) insist on the necessity to ensure long-term public financing and benefit from the advantages of a regulatory framework. According to them, the intervention of the government in funding Living Labs drives business to internalize costs, protects niches for innovative activities and helps protecting goals that are unbiased by private economic interests (Von Geibler et al., 2014). However, Guzmán et al. (2013) highlight the high amount of resources needed to launch a Living Lab and propose to

look at non-traditional models to fund innovation, such as joint ventures or crowdfunding. In addition, in order to guarantee the financial sustainability of the Living Lab's innovation outcomes, suitable intellectual property rights should be adopted (Mulder et al., 2007). According to Eriksson et al. (2005), an appropriate rewarding and incentive system should be set up in order to secure pay-back to all the actors involved. However, the Alcotra Innovation project launched in 2010 showed that it is better to address the intellectual property rights issue at the beginning of the contractual relationship between the actors involved in order to reduce the risk of disputes afterwards (Clermont & Fionda, 2016). For this reason, a contractual agreement should generally be signed on an ad hoc basis before the launch of the project. Thus, some investors will request a negotiation for the rights assignments before investing in a Living Lab's project (Dubé et al, 2014). It is therefore important to settle an adequate value creation model enabling the recognition of the actors' contribution in the innovation success. In that view, Dubé et al. (2014) stress the necessity to deal with confidentiality agreements a priori and to clearly communicate the rules in terms of intellectual property rights. They also raise the importance of developing a minimum degree of legal knowledge within the Living Lab in order to negotiate and generate the legal documentation regarding intellectual property rights (Dubé et al., 2014).

When we consider the culture and values shared in Living Labs, Von Geibler et al. (2014) stress the importance of placing learning purposes at the center of the Living Lab's culture, even though it is not a characteristic of Living Labs by definition. The authors promote the integration of a dynamic feedback process in order to support reflexive learning and goal adjustment. Guzmán et al. (2013) also highlight the importance of evaluating lessons learned and prepare further initiatives in collaboration with users, researchers and designers. Nevertheless, Hakkarainen and HyysaloHow (2013) say that it often requires painstaking and conflict-ridden effort to establish such collaborative learning culture. For this reason, the authors recommend to pay attention to three elements in order to promote learning in Living Labs: (1) priorities and restrictions; (2) conflicts; and (3) innovation intermediaries. The first element is the importance of charting the priorities and restrictions of the project at the beginning of the collaboration. This permits to understand the issues each actor is most concerned about, those that will be difficult to compromise and the areas of flexibility. The second element is the management of conflicts within Living Labs. According to the authors, conflicts will emerge between the different parties and the Living Lab should be prepared to

handle those situations. This is why they stress the importance of hiring a competent intermediary, establishing an adequate governance structure, reviewing the needs of the projects in the course of the collaboration, planning regular face-to-face meetings, etc. This facilitates learning and help build trust between the participants. They also recommend seeking adequate collaboration tools, such as prototypes, mock-ups, and digital collaboration platforms. The third element is the intervention of innovation intermediaries in order to mediate between developers and user contexts. Those intermediaries should be independent and able to build trust between parties. They also should be ready to adjust to unexpected situations and play different roles; they therefore need creativity and negotiation skills (Hakkarainen & HyysaloHow, 2013).

Last but not least, even though new Living Labs' initiatives are often financially supported by public funding, project leaders should develop a viable business model in order to secure the sustainability of the Living Lab's activities on the long run (Dubé et al., 2014). Building a viable business model is therefore a key component of the success and the sustainability of Living Labs in terms of social and commercial outcomes. Further recommendations have been developed in the Appendix 11 in order to build a viable business model for Living Labs.

From this short literature review, we can consider that there are 10 major key success factors underlying the Living Labs' activities. The first one is the creation of a strong community of users through the exploration of the users' interests and habits. The second one is the capacity to build trust and commitment with users by motivating users with intrinsic or non-intrinsic rewards, activities and support services to facilitate their involvement in the innovation process. The third element that fosters the success of Living Labs is the involvement of all the necessary stakeholders in the project through a sufficient level of openness, as well as an optimal degree of interaction between the stakeholders to maximize the innovation outcomes. This can be achieved through a clear thematic focus and a mixed set of stakeholders to promote knowledge exchanges and good collaboration. The fourth key success factor is the type of projects launched. By focusing on clear and precise goals and by developing a project portfolios with multiple applications, Living Labs increase their chances of success. In addition, successful projects require a mixed set of methods and tools in order to discover new opportunities during the process. Next, a well-defined infrastructure, as well

as the implementation of technological and ITC systems to facilitate the innovation process and support interaction and communication seem like a “must-have”. Another key success factor is the implementation of a good governance structure to align the management at a strategic and operational level with the Living Lab’s goals on the long run. The eighth factor highlighted is the implementation of a robust funding system through the involvement of public agencies and the consideration of non-traditional models to fund innovation, as well as a rewarding system defined a priori to deal with confidentiality agreements. Also, collaborations should be built around common values and a culture of learning. Finally, the creation of a viable open business model is the last critical element to promote the success of Living Labs. All those elements should be considered when establishing or managing a Living Lab in order to be successful on a long-term perspective. In the next section, we will briefly review the elements that could put the sustainability of a Living Lab at risk.

2. Risk assessment

In this section, we will explore the different elements that could endanger the Living Lab’s sustainability. The first observation we can make is that the longevity of a Living Lab can be improved when the financial support come from several sources, such as universities, government, investors and private companies. However, focusing on one single type of funding is risky for the sustainability of a Living Lab. Indeed, Mastelic et al. (2015) state that launching a Living Lab with the financial support of a university only is risky in the sense that the university could stop funding the Living Lab at the end of the research project term, which could cause the Living Lab cessation due to lack of continued funding. The authors add that the same scenario could happen in case of private or public funding. They take the example of MobiLab in Geneva, which saw its public funding source disappear when new politicians entered their mandates and did not support Living Labs anymore. This illustrates the fact that a Living Lab without a diversified funding stream could be at risk (Mastelic et al., 2015). Also, when it comes to public funding, Von Geibler et al. (2014) mention the possibility that public agencies do not see the potential of specific Living Labs’ projects and therefore provide exclusive public support for other experiments. This illustrates the fact that public funding is not predictable and may not be granted if the project does not match with political goals or if the government does not see the added value of the project. Von Geibler et al. (2014) add

that some political objectives could involve risk adverse funding principles, which do not really fit with the needs of innovative activities.

Then, even though private companies are especially interested in reduced development cycles for the development of a new product, service or technology, Von Geibler et al. (2014) argue that time-constrained and reductionist research designs could be detrimental for Living Labs' projects. They see short-time horizons and special-interest-led choices for specific developments as barriers to the success and the sustainability of Living Labs (Von Geibler et al., 2014).

In addition, the Von Geibler et al. (2014) highlights the fact that open innovation is altered when firms can obtain a competitive advantage by competing instead of cooperating. In that sense, if several companies belong to different markets and can propose a differentiated offer based on the same innovative technology, it enhances the cooperation between firms. The authors also argue that rivalry can stand in the way of open innovation processes and therefore put the success of Living Labs' at risk (Von Geibler et al., 2014).

Concerning the goals settings, as many stakeholders with divergent interests are involved, it is crucial to set up well-defined goals in order to follow a red line all along the iterative steps, while keeping some flexibility to optimize the scope of actions. In that view, according to statistics realized on European Living Labs, Planitz, Hanlen and Suominen (2013) state that the Living Labs with vague or no project outlines have experienced more failure in their projects. It illustrates the high rate of unsuccessful projects when Living Labs define vague objectives in the context of innovative projects.

Concerning the collaboration process, Hakkarainen and Hyysalo (2013) insist on the fact that there should be a learning process "for" interaction before reaching an effective learning "in" interaction. Otherwise, collaboration can become volatile on the long run. In their case study, they observed that the stakeholders were unable to understand and cater for each other's concern in the early phases of the innovation process (Hakkarainen & Hyysalo, 2013). Another issue mentioned by Von Geibler et al. (2014) is the different terminology between socially oriented sciences and technology-oriented sciences that can make cooperation difficult in Living Labs. According to the authors, "the transdisciplinary character of Living Labs poses a barrier for their inclusion into the science system" (Von Geibler et al., 2014, p.587). They also mention that private companies' focus on technical functionalities

represent a risk for collaboration and user acceptance. If the Living Lab does not develop inter- and transdisciplinary communication between the different stakeholders, this can be detrimental to their success (Von Geibler et al., 2014).

To sum up, we identified five main risks related to the sustainability of Living Labs' initiatives. The first one is the origin of funds that are invested in the Living Lab on the long run; relying only on one source can be risky, especially on the long run. The second element that could jeopardize the success of Living Labs is the consideration of a shot time horizon in projects developments. Then, the possible rivalry present in the R&D field could increase the firms' reluctance to collaborate. The next element that increases the risk of failure of Living Labs is the definition of broad and unclear objectives in the project. Finally, collaborations issues can easily arise on the long run when many stakeholders with divergent interests participate in Living Labs, which can be detrimental for the Living Lab's sustainability. We thus learned that opting for a diversified funding sources, long-term horizons for projects, clear and well-defined objectives, mechanisms to foster collaboration and define a common ground for all stakeholders' interests can lower the risks of failure for Living Labs.

Conclusion

The main objective of this thesis was to explore and clarify the Living Lab approach in the light of the innovation landscape. Our main conclusions allow us to understand the Living Lab concept as an approach positioned between the two broad concepts of open innovation and user innovation. By retrieving the ideas of internal and external knowledge exchanges, innovation intermediary and value creation for multiple stakeholders from the open innovation stream; and the idea of active user involvement in the product and concept design and the focus on the utility gains for users from the user innovation stream, the Living Lab concept can be seen as a bridge between open innovation and user innovation, where the locus of innovation becomes dynamic and comes from the collaboration between multiple stakeholders. Closely related to the co-creation concept, Living Labs distinguish themselves from the fact that they collaborate with users and other stakeholders along the whole innovation process, and they orchestrate the stakeholders' interaction in a specific infrastructure facilitating co-creation. By identifying the convergences and divergences amongst numerous definitions in the Living Lab literature, we opted for the following definition, including the five main characteristics of Living Labs: "A Living Lab is an open innovation ecosystem taking place through a public-private-people partnership that aims to develop new products, services, businesses or technologies through active user involvement and co-creation as of the early stages of the innovation process by using multiple innovative methodologies to create, test and validate innovations in real-life settings within multiple and evolving environments". By reviewing the elements of our definition, we confirm our decision to place the Living Lab between the open innovation and user innovation approaches, as it includes the major elements of those two line of thoughts; namely the exploitation of several external sources of knowledge illustrated by the multi-stakeholder approach, and the involvement of users in the development of innovations.

After having set the theoretical boundaries of "what is a Living Lab", the exploration of "what is not a Living Lab" through the comparison between Living Labs, Fab Labs, testbeds and the lead user method brought several insights to light. We conclude that the Fab Lab is the closest approach to the Living Lab, as they both actively involve users in the process of creation and share knowledge and skills with other stakeholders engaged in the process. In

addition, those two approaches leave the boundaries of the firm to establish a real co-creation process in a specific infrastructure. Nevertheless, the Living Lab is the only one out of the four approaches to test and validate products and services in real-life setting. It also distinguishes itself by using a design method “with user”, illustrating the fact that the contributions of users are valued in the same way as the contribution of other stakeholders. Lastly, the Living Lab is the only approach that can address explicit, observable, tacit and latent needs by using multiple methods and by involving the users at each step of the innovation process.

By exploring how Living Labs work concretely, we understood that four main actors lied under the public-private-people partnership; users, enablers, utilizers and providers, each of them linked together by an interdependence relationship. Nevertheless, one of those stakeholder groups is generally at the origin of the Living Lab and sets up the main objective of the Living Lab. Theoretically, those actors generally collaborate through a phased or an iterative innovation process, but in practice, they sometimes customize the innovation steps according to their needs. Within each step of the process, different methods and tools are used, from communicative methods, observation, statistical analysis, to co-creative and testing methods. The users’ activeness is more and more emphasized in the methods and tools as the innovation process moves forward. All those roles, relationships, processes and methods form together the innovation environment of Living Labs.

In addition, by confronting the insights derived from the literature to a Living Lab, Imec iLab.o, and a Fab Lab, Makilab, we can conclude that Living Labs are domain-agnostic, applicable in the B2B, B2C and B2B2C fields, and represent an appropriate tool for regional projects in collaboration with SMEs in a variety of fields. Nevertheless, compared to Fab Labs, Living Labs are more adapted to complex projects related to social, health-related or environmental issues. Moreover, the contexts requiring the addressment of a unique common goal on the long term in the perspective of commercializing a new product, service, business or technology are considered as the most suitable for the initiation of projects in Living Labs. This goes along with markets characterized by a high degree of uncertainty, where users’ needs are not predictable and where users can contribute significantly by providing their tacit knowledge.

The last step of this thesis has been to explore the main implications for the management of Living Labs. The importance of a Living Lab manager has been stressed in

order to orchestrate the interaction between stakeholders, provide access to support services for end-users and deal with the intellectual property issues, as well as an independent innovation intermediary to handle conflicts. In addition, the motivation of users represents an important challenge for Living Labs; intrinsic or non-intrinsic rewarding systems as well as integration systems can be helpful in order to make the users feel involved, but it is also important to bring users together around common interests in order to build a strong and committed community based on trust. Regarding the type of projects, it has been showed that Living Labs should follow clear and well-defined projects with multiple applications on the long run in order to increase their chances of success. A diversified source of funding, a clear governance structure aligning the strategic and operational objectives to the Living Lab's goals, and the communication of shared values and a culture of learning are amongst the key success factors in Living Labs. As a conclusion, we can state that the implementation of mechanisms fostering collaboration and the definition of a common ground for all stakeholders' interests are essential in Living Labs' settings, as the locus of innovation lies in the collaboration.

The principal contribution of this thesis is the clarification of a high number of facets of the Living Lab concept, such as its origins, its link with other innovation approaches, its nature and main characteristics, its mechanisms, its scope of application and finally its management implications. Even though this thesis does not bring to light a radical new discovery regarding the Living Lab concept, two dimensions make the originality of this thesis; the proposition of a new definition to describe the Living Lab concept, and the proposition of a fit assessment model to discover the most suitable contexts for Living Labs, compared to Fab Labs.

Finally, we emphasize on the fact that the model proposed is a first attempt to clarify the distinction between two new emerging concepts, the Living Lab and the Fab Lab. Therefore, the empirical verifications conducted with Imec iLab.o and Makilab are considered as useful, but not sufficient to attest the robustness of the model. With this in mind, further research could be required to explore other empirical cases and confront them with the model, in order to improve this theoretical framework towards an advanced tool capturing the field reality. In addition, further research could be useful in order to compare the costs and benefits of implementing a Living Lab or a Fab Lab, with the objective to move from a fit

assessment model towards a decision model, that could be even more useful for public agencies in order to know in which approach they should invest.

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