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Living Labs as Tools for Open Innovation (*)

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Abstract: This paper presents a Living Lab in Stockholm as a focal point for discussing how the Living Lab concept can be extended and used for engaging in multi-organizational open innovation. Although Living Labs have been found to have potential for driving innovation through collaboration, more research is necessary to find tangible ways of organizing this kind of collaboration. The paper is explorative and empirically induced from an ongoing development and practical implementation of a Living Lab at Stockholm-Arlanda Airport - Sweden's largest airport situated outside Stockholm. This Airport Living Lab involves a number of large industrial and academic stakeholders aiming at ensuring multi-organizational innovation delivery. Of special interest is how the Living Lab concept should evolve to continue creating conditions for user-oriented innovations through multi-organizational collaboration which would not necessarily take place otherwise. Congruent with the explorative aim of the paper it ends up in a discussion about five propositions that should be on the agenda of research and implementation for Living Lab founders in the coming years.

Key words: Living Labs, Open innovation, Electronic Collaboration Tools

■ What is a Living Lab?

There is clearly not one common definition that wholly encompasses the activities in the Living Labs across Europe. Although the concept of Living Lab is still tentative and in progress, it has become a strong theme in the

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seventh framework program 2007-2013 of EU, an interest which is indicated by the pan-European network "The European Network of Living Labs" today consisting of 129 members (ENOLL, 2009).

Living Lab is neither a traditional research lab, nor a test-bed (STÅHLBRÖST & BERGVALL-KÄREBORN, 2008; STÅHLBRÖST, 2004; BALLON, PIERSON & DELAERE, 2005), but what is it then? The phenomena transcends many research disciplines - innovation management, user-centered design, entrepreneurship, cognitive science, organization theory, management models, context awareness, human-computer interaction, information science and social computing, to name a few.

A conventional description and aim of current Living Labs in Europe is an entity that "directly involves end users into development of new applications and services by providing bilateral access, on the one hand the consumer to the new and emerging services, and on the other, the developing enterprises to the consumer feedback. This integrates the consumer into the development process, with the potential to ensure reliable market evaluation, resulting in a significant reduction of technology and business risks." (MIRIJAMDOTTER *et al.*, 2006, p. 2). Tracing the origins of the Living Lab, an early proponent and possible founder of the concept of a Living Lab was a group of researchers led by Professor William Mitchell at MIT School of Architecture and Planning and MIT Media Lab working on among other things technology in smart cities and homes. If so, the Living Lab concept has traveled far from its origin and is now used for innovation in a wide array of settings including tourism, advertising and marketing and ICT-services.

Still, perhaps the most striking common rationale between existing European initiatives involving Living Labs is that user involvement, as well as the potential sheer volume of input from a larger number of stakeholders, can bring about and improve innovation. Prevalent common characteristics also include openness and an aim for increasing cooperation between industry and academia (STÅHLBRÖST, 2004; Eriksson, Niitamo & Kulkki 2005). Sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts (ERIKSSON, NIITAMO & KULKKI, 2005) has been said to provide the core and strength in the Living Lab concept which fits well into the theories on open innovation.

These co-operations between industry and academia as well as with the government e.g. in the form of local municipalities, implies that Living Labs typically operate in the domain of public-private partnerships often as part of

regional, national and EU-sponsored innovation programs. But while programmes like the European Framework Programmes and EUREKA (EUREKA, 2009) provides centralized and complex, at least in terms of participation criteria, structures for jump-starting development of formulated ideas into new products and services, the Living Lab movement is more concerned with collection and creation of the idea itself from a stance that everybody is welcome to participate. This open setup is letting users bring in ideas with minimal resource commitment from their part.

The concept of Living Lab also seems to have resonated most strongly in already existing so called test-beds for ICT products and services where user-involvement was already high on the agenda (STÅHLBRÖST, 2004). The existing Living Labs in the ICT area are now spread all over Europe e.g. Austria, Spain, Germany, Sweden, Portugal, Finland (Corelabs, 2006; European Commission, 2009).

The discussions presented in this paper are the results from an ongoing research project on the design and setup of a Living Lab. In the process of bringing stakeholders together and preparing for the launch of this Living Lab, there was a need to conceptualize the different functions that would have to be in place before the Living Lab was launched to the public. A search for best-practices started through discussions with existing Living Labs founders especially in Sweden and Finland, on Internet blogs, in conferences, and in other forums for Living Labs as well as going through documentation on existing Living Lab activities (Corelabs, 2006; FØLSTAD, 2008) and academic publications (MIRIJAMDOTTER *et al.*, 2006) on the subject.

A number of observations gave rise to a whole series of questions regarding how this concept should be taken to the next level in terms of economical sustainability, legitimacy, attractiveness and value-creation for already involved and future relevant private as well as public partners. With this background in mind, the aim of this paper is to present well-grounded critical propositions for the potential benefits of the Living Lab concept and problems to overcome in the coming years.

The empirical setting - Airport Living Lab of Stockholm

In the spring of 2007 a consortium was put together with the purpose of applying for funding from the Swedish Governmental Agency for Innovation Systems (VINNOVA) to establish an airport-oriented Living Lab at

Stockholm-Arlanda Airport. The consortium was granted funding and began an establishment project in August 2007 to set up the Living Lab within two years.

The consortium consisted of five parties: 1) LFV - the Swedish Civil Aviation Authority - the governmental authority responsible for managing Arlanda airport, 2) SAS Ground Services - the ground handling division within Scandinavian Airlines that is the main ground handling company at the airport, 3) CSC (Computer Sciences Corporation) – a global IT-consulting, systems integration and outsourcing company which participates with its Airline Innovation Program and experience from innovating airlines and airport environments, 4) NITA - the National IT-user Centre at Uppsala University - centre aiming at organizing research and contributing to the Swedish national debate on user-friendliness and user-oriented IT-development, and 5) CIC - Center for Information and Communication Research at the Stockholm School of Economics -information and competence center to coordinate and pursue business research on the use of communications and information technology.

One critical practical feature of the Airport Living Lab has been the electronic collaboration system or "open innovation software" called Arlanda IdeaTorrent. The system is under development throughout the project to serve the open innovation efforts of idea generation and user evaluation in the Living Lab. The system has been the primary channel between users and the Living Lab during the pilot. The system is built from IdeaTorrent which is a Free Open Source Software (FOSS) licensed under GNU General Public License, which means you can freely download it, modify it and distribute it (<http://www.ideatorrent.org/>). Functions in the Arlanda IdeaTorrent so far include web-based submission of problems and solutions, search and grouping of submitted ideas (e.g. into "Ideas being developed" and "Implemented ideas"), and voting and commenting on these ideas.

A Living Lab could be particularly suitable for the airport environment because of: 1) the inherent need for forums where multi-organization innovation can take place. An airport hosts a number of quite different (in terms of e.g. organizational characteristics and business objectives) stakeholders who co-exist and, we argue, should co-innovate. The Living Lab has the potential for letting these shops, airline ground handling operators, security firms, and logistics firms collaborate on innovation. 2) The airport provides a challenging environment in terms of opening up a constructive dialogue with often stressed end-customers, in order to activate them in the innovation process. That these travellers can be found in

different tempos ranging from inactivity to frenetic activity is somewhat unique to the setting.

If executed with the help of suitable IT-tools, the approach of the Living Lab is well designed to opening up this dialogue with users in their actual user environment.

Theoretical background - Open innovation

The main paradigm underlying the processes in and rationale for the Living Lab concept - at least as it has developed in Europe - comes from theories of open innovation (CHESBROUGH, 2003, 2006) and the shift from a closed to an open innovation paradigm. West & Gallagher (2006) define open innovation as systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels.

One main underlying assumption in the Living Lab concept is in fact that (especially large) organizations only use a small portion of their stakeholders in their innovation processes (KANTER, 2006). In line with this we argue that two facets of open innovation, both related to novel ways of thinking about collaboration in the innovation process, are especially relevant to the Living Lab concept: user-collaboration and inter-organizational collaboration.

User involvement is a prevailing idea in the open innovation paradigm and long prior to this theorizing; VON HIPPEL (1986) advocated using customers as a source of new-product solutions and ideas. It has been argued that the users (here in the meaning of end-customers or consumers) are in fact a more productive source for innovation than the producers (THOMKE & VON HIPPEL, 2002). For the Living Lab the rationale is that user involvement, as well as the potential sheer volume of input from a larger number of stakeholders, can bring about and improve innovation. Also the most prevalent common characteristics of existing European initiatives involving Living Labs include end-user involvement, openness, and cooperation between industry and academia (STÅHLBRÖST, 2004; ERIKSSON, NIITAMO & KULKKI, 2005).

The case for using multi-organizational collaboration to strengthen innovative activities is strong. Multi-organizational collaboration is suggested as beneficial for the innovative performance of firms, which has been

supported by large-scale empirical evidence (FAEMS, VAN LOOY & DEBACKERE, 2005). Faems, Van Looy & Debackere draw from literature to list some of the reasons including access to complementary assets, encouragement of transfers of tacit and codified knowledge resulting in mobilization of resources that would otherwise be hard to mobilize or develop, and spreading of costs for research and development among parties leading to risk-reductions.

O'CONNOR & AYERS (2005) point out that large, established, sometimes stagnant companies have throughout the years tried to and failed to internally organize corporate venturing organizations, incubators, or "renewal engines" that aims at building the new really big, growth opportunities. These constructions have not lasted very long and arguably few have had real impact on their companies' growth. Living Labs are proposed to become a possible new focal point for multi-organizational collaboration on innovation and potentially also opening up other business opportunities with involved firms. The discussions and decision that organizations have to face in line with the Living Lab participation may increase the attention on innovation also inside the organization. In the open innovation paradigm firms leverage external knowledge. This allows them to focus any internal R&D capability on unique internal knowledge that is not available externally. The Living Lab is arguably supposed to efficiently contribute to this external knowledge by acting as a supplement to the internal innovative activities of organizations.

Note on method – A pilot study

In order to explore Living Labs, we have conducted a single case study. The intention has been to get a rather close look at how a Living Lab works. Case studies are useful for addressing questions regarding how and why phenomena are the way they are, and why agents and organizations act the way they do, often providing hypotheses about behavior rather than validating general claims about behavior (EISENHARDT, 1989). Hence, the case study method was deemed useful for the purpose of this paper, given the study's exploratory and tentative nature (YIN, 2003). Although the researchers in the project are in the middle of data collection from the pilot study, we choose to present some early empirical material in the form of observations in line with the propositions.

The observations draw from three major sources. First, users' activity in the electronic collaboration tool Arlanda IdeaTorrent. During the pilot study, the Living Lab interface with users consists of a stand with three computer monitors placed in the Airport. The computer monitors are linked to Arlanda IdeaTorrent through an Internet connection. This method makes it possible to collect rich data through observation and interaction with actual users at the time when using the tool. A questionnaire has also been used where 57 users on site have provided evaluation of the Living Lab. Technical limitations in Arlanda IdeaTorrent have so far translated into user access only being possible from the stand inside the airport. Therefore it has not been possible to assess e.g. location independent idea generation by larger numbers of users. Still the total number of submitted ideas is 98 as well as 181 votes on these ideas. Second, we have conducted focus group interviews with 11 airport employees in order to evaluate their interest in participating in open innovation as well as how that practically would work out. Focus interviews provided the opportunity to gather data which could not have been obtained in other ways (CUNNINGHAM, 1993). Five 3-hour sessions with these employees as well as a questionnaire was arranged. Third, researchers have had ongoing access to discussions and activities among founding commercial stakeholders regarding the design and start-up of the Living Lab. This includes participation in planning and board meetings.

■ A Living Lab approach

Propositions for further design and research

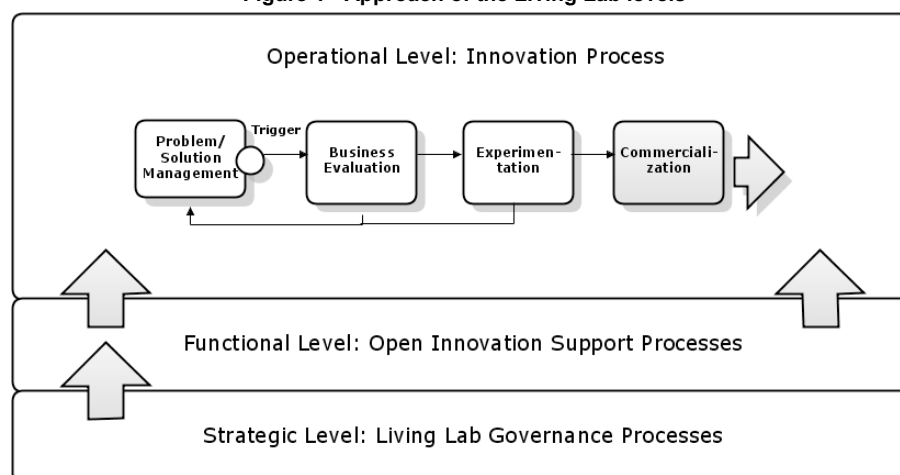
We use the proposed approach of the Airport Living Lab, not only as a conceptual way of describing the forthcoming activities and potential benefits with the Living Lab, but also as a way of focusing and organizing the project resources. In the following we will walk through the parts of this approach with the purpose of highlighting some propositions we posit as valuable to examine closer throughout the project. In this paper we are limiting the discussion to the stages in the innovation process leading to commercialization.

We are proposing an approach consisting of three levels illustrated in Figure 1 as a simplified way of describing the activities in an evolved Living Lab. The core of a conceptual description of the Living Lab lies in the innovation process. Previous literature has proposed possible stages of this innovation process moving from idea generation to implementation (e.g.

DESOUZA *et al.*, 2006). Some innovation processes developed specifically for Living Labs have been previously documented, although discussions or investigations of existing Living Lab processes are still rare (FØLSTAD, 2008). One important distinction between such innovation process models (McNEESE, 2004; PIERSON, LIEVENS & BALLON, 2005) and the presented approach, is the emphasis on providing not only technical, but also business evaluation early in the innovation cycle, as well as wrapping of the operational level in support and governance processes.

The top layer of the approach (Operational level) deals with the actual open innovation process and flow of ideas from idea generation to commercialization. Problems and solutions are managed in the first module in this layer ending in a screening mechanism or trigger which decides, based upon predefined criteria on user activity, when a problem or solution will transcend into the Business Evaluation module followed by Experimentation and Commercialization. Two parallel processes move along these modules as the foundation of the Living Lab: in the second layer open innovation support processes (Functional level) and in the third layer Living Lab governance processes (Strategic Level). Support processes is e.g. the development of an electronic collaboration tool while governance processes include e.g. how to make decisions on criteria for invitations of new Living Lab partners or what direction the Living Lab should take. In the following we focus the Operational level as a vehicle to argue for our five propositions for further research.

Figure 1 - Approach of the Living Lab levels



Problem/solution management

The purpose of this initial stage is to bring problems and solutions into the Living Lab as well as match and start evaluating these problems and solutions with the help of users. This is where the raw material is supplied to the Living Lab innovation process and possibly the most important stage of the process. With problems/solution management we mean the whole set of e.g. routines and tools including access channels for users into the Innovation process. In practice, submissions (e.g. a problem statement) are made by users (e.g. a member of the airport staff) through a certain channel (e.g. an on-line form), which is handled and stored by the Living Lab (e.g. a specific database).

Still, the area of "innovation process initiation" or "initiative emergence" is under-researched where more attention has been put on later stages than the "fuzzy front end" of the innovation process also in practice (TALKE, SALOMO & MENSEL, 2006). The propositions related to this stage are intended to strengthen this fuzzy front end.

We argue that the stakeholder called "user" in a Living Lab should not be confined to the end-customers or consumers. Previous studies have indicated that especially large organizations under-utilize the creative potential of its own staff (KANTER, 2006). The reasons for this has been stated e.g. as rigid and hierarchical structures, corporate culture, unclear incentives to innovate among the staff, focus on "elite" researchers and departments leaving other staff outside the innovation process. The Living Lab, existing as an external entity to the walled garden of the participating partners' organizations, has the potential to neutralize these adverse effects on the participation of larger numbers of partner organizations' staff.

The pilot study indicated that invitation of both end-customers and staff into the open innovation process was fruitful. Although 85% of ideas were submitted by travelers/end-customers, discussions on ideas were invigorated when both employees as "experts" on existing processes or technologies, and travelers with fresh ideas clashed. Our hands-on experiences were that technicalities in the airport environment are hidden from the end-user. If letting the end-users innovate without dynamic input from "experts" (in the form of staff), the innovation outcome risk becoming incremental at best. Arguably bringing in experts with the suitable timing increases the chances to make greater innovative leaps. At the same time there were challenges with openness when both staff and end-customers were part of the same innovation process – collaborating at the same time

and through the same channel. The employees felt that some ideas and knowledge among them could be misunderstood and misinterpreted if presented to end-users in the Arlanda IdeaTorrent. There were also concerns about problems leaking out to media and damaging corporate image.

In the Arlanda airport environment there are around 15 000 employees working and 18 million passengers passing by each year (Luftfartsverket, 2007). Actors present involve 80 operating airlines, 6 handling agents, as well as 128 commercial companies providing restaurants and shops. There is a clear potential in activation of these resources for innovation. This leads down into the first proposition.

PROPOSITION 1: Activation of not only customers but also other relevant user groups like staff of Living Lab partners will increase input of ideas into the innovation process.

A crucial question for the sustainability of any Living Lab is how to attract a high quantity of submitted problems and solutions entering the innovation process i.e. how to motivate or give incentives to the real world participation. In order to reach this target a proper understanding of the users' incentives to participate is necessary. A basic differentiation of incentives is in intrinsic sourcing from internal influences and extrinsic sourcing from external influences, where the extrinsic in turn can be divided into material and non-material incentives (KRUGLANSKI, 1975; TALKE, SALOMO & MENSEL, 2006). Research has shown that measures to boost intrinsic motivation produce a stronger effect for the generation of initiatives contrary to extrinsic motivators (AMABILE, 1998).

Research on the successful Open Source software community may give some insight and it is for us to assess what can be learned and transferred from innovation in the Open Source software community to a Living Lab (AHONEN, ANTIKAINEN & MÄKIPÄÄ, 2007; LAKHANI & WOLF, 2005; WEST & GALLAGHER 2006). In the virtual Open Source environment large numbers of highly skilled software developers (and users) dedicate considerable amounts of time and effort to the creation, expansion, and ongoing maintenance of "free" products and services. LAKHANI & WOLF (2005) report on four distinct clusters (approximately equal in size) of response types when asking about what motivates them to contribute. In summary self-fulfillment and learning, joy of everyday innovation, career progress, and call of duty/part of a bigger whole has proved to work as

strong motivators for user contribution to innovation. It seems plausible that some or all of these factors should also be activated in a Living Lab.

The pilot study indicates that the major incentive for staff to participate in the open innovation process is to make their work easier. All participants in the focus group interviews ranked "Simplify my work" as the primary reason and top incentive. In second place came "Stimulating to come up with ideas together with other persons", and in third place "Making the company more profitable", fourth place was "Intellectual stimulating" and "Improve my competence", and fifth place "Economic compensation".

As with all technological gatekeepers, these experts must be properly identified and motivated to participate. Literature has pointed out how employees acting as gatekeepers in organizations can provide positive as well as negative forces (ALLEN, 1977). In this case positive if the technological gatekeepers can be identified and made to use their, per definition, vast knowledge to propel ideas in the Living Lab, even if these ideas may come from the "outside". Negative if these gatekeepers feel threatened by the pace and perhaps new incentive structures in open innovation and use their positions to hinder innovation to take place.

Whether incentives for collaboration on innovation includes personal fulfillment to solve everyday problems relating to ones own situation, financial gains, and career progress, what incentives that are relevant to a specific user group will vary between groups. In order to maximize the number of submissions as many relevant incentives as possible related to the users should be taken into consideration. While research has indicated that intrinsic incentives have been more effective in stimulating generation of new ideas, we are interested in testing a mix of several types in the Airport Living Lab setting.

PROPOSITION 2: A Living Lab should aim at providing several user incentives relevant to a specific user group in that it will increase the quantity of submitted problems and solutions from these users.

Existing research provides insights into how electronic collaboration tools also known as "Electronic Knowledge Networks" or "Social Media" can be used to cost-efficiently activate users in various stages of the innovation process (AHONEN & LIETSALA, 2007; HEINONEN & HALONEN, 2007). We can go as far as to posit that without these tools, the open innovation paradigm as suggested in a Living Lab setting would not be feasible.

These tools aim at creating electronic communities by providing access to a group of peers dealing with similar knowledge issues. We could theoretically consider the users on site in the airport as part of a community of practice (BROWN & DUGUID, 1991) with the electronic collaboration tools to be designed with the purpose of enabling discussion, mutual engagement, and exchange between members of this community of practice. These tools for idea promotion and suggestion composing are now under construction and adaptation in the Airport Living Lab, drawing experiences from various Web 2.0 tools such as Wikis which have already proven to have an impact on customer-driven innovation (DESOUZA *et al.*, 2008).

The pilot study suggests some pragmatic lessons on the design of electronic collaboration systems as channels used in a Living Lab. During the pilot study Arlanda IdeaTorrent has not been a fully satisfactory system for handling users' ideas. The main reason for this is that the system was seen as too time consuming for users in a time sensitive environment. Seven steps are currently necessary to submit a problem/solution. The seven steps have not only been observed to be time consuming, but also difficult to understand for a user unaccustomed with the system. It is hard to approximate how many potential users have terminated the idea submittal process due to such difficulties, but this urges continuous development into simplification and increased usability. Another observation has been that feedback is helping to make the users become more involved in contributing problems/solutions. Feedback is presently mainly provided through the option of commenting on previously submitted problems/solution and notification on the status of the submission such as is it has moved to development. More emphasis on developing mechanisms that provide feedback to users should be on the agenda.

PROPOSITION 3: Effective usage of electronic collaboration tools with emphasis on simplicity and iterative feedback-loops are crucial for inviting users into the Living Lab open innovation process.

Business evaluation

Larger volumes of ideas as input do not by themselves necessarily lead to better innovation. Ideas have to be evaluated which takes considerable effort and discipline. At this stage of the approach a problem/solution has fulfilled the set criteria and the trigger mechanism passes problem/solution on to a business evaluation.

We posit that the innovation process inside a Living Lab has lessons to learn from the company development process overall successfully utilized by venture capital (VC) firms around the world (FREEMAN & ENGEL, 2007). The venture capital industry has managed to provide value through cost-effective processes for attracting, screening and selection, business evaluation, and promotion of prospective business opportunities. The creative process of innovation tends to generate complexity in organizations as in deals and venture capitalists have worked out a set of practices to reduce this complexity. One of the more obvious services for VC firms perform, and are paid for, is the sourcing and evaluation of investment opportunities.

In the Airport Living Lab we are suggesting that a trigger sends an alert to a human operator to start this business evaluation. The human operator denoted Investment Manager, evaluates business potential as well as strategic fit with Living Lab partner organizations for the problem/solution. This investment professional has the mandate to gather information and with the help of experts involved inside or outside the Living Lab provide a sound business evaluation of user submissions and formulates a business proposition. In the case of the Living Lab an investment committee would consist of partners from each participating organization.

The role of the Investment Manager should act as a neutral party and perform the parts of business evaluation that users will have a hard time doing because of information asymmetries and Living Lab partners may be ill-fitted to do because of bias, e.g. assessing strategic fit for an idea or assessing the financial impact of an idea on the whole airport environment. The criteria the Investment manager will use to assess submissions are governed through the governance processes in place. These criteria are crucial and must be transparent. Criteria can focus on e.g. EBITDA, customer experience, speed to market, internal cost reduction or brand investment and this focus must be agreed on and clear to all Living Lab partners.

In order for a Living Lab to create sustainability, its partners must feel that it gives them the best return on their innovation investments. Making a thorough investigation of not only perceived value by users but also commercial potential as well as the strategic fit with participating organizations early in the process will save money in the long run.

PROPOSITION 4: Performing a thorough and neutral business evaluation early in the innovation process provides the most efficient usage of limited resources of the Living Lab.

Experimentation

The purpose of this stage is to see how the business proposition should best be developed into a product/process ready for commercialization. At this point a problem/solution grounded among users has been found to have positive commercial potential and to be in line with the businesses of the participating partners. The problem/solution has been translated into a business proposition and a decision has been taken to dedicate resources to further develop the idea into e.g. a product or service and a phase of experimentation starts. It is then crucial that the Living Lab can provide an array of flexible ways of experimentation in order to be able to handle innovations ranging from products, services, processes as well as more abstract concepts like business models. In our approach of the Living Lab, the experimentation options provided by the Living Lab will tap into the actual development made by each relevant Living Lab partner.

Arguably this stage of the innovation process is where tools and processes have been developed furthest in the existing Living Labs. Methods used range from simple collection and analysis of customer complaints, to focus groups, and also advanced usage of ICT enabled data collection and user collaboration including online interviews, log analysis, virtual product testing, and user toolkits (CORELAB, 2006). Experimentation is also a relatively well-researched area where developers can rely on findings regarding effective testing practices including beta testing and prelaunch forecasting methods (see review e.g. in OZER, 1999).

The Airport Living Lab will draw upon these experiences and provide a flexible menu of methods to help partners develop test business propositions in real life situations. In one area we posit that the scope of the Living Lab as deployed in Europe could be extended. The Living Lab concept has so far been focusing on innovation of ICT (Corelabs, 2006). This is natural due to its extension from the ICT test-beds or science parks (ERIKSSON, NIITAMO & KULKKI, 2005). If suitable to the environment and partner involvement, an evolved Living Lab concept could arguably widen its scope in this sense and also be able to handle innovation not related to ICT. Additionally it would be interesting to test whether the Airport Living Lab innovation process can be

designed to also handle experimentation of more abstract innovations like novel business processes or business models possibly utilizing proven methods like scenario analysis or business process modeling.

PROPOSITION 5: A Living Lab should be able to handle innovations regarding products, services and processes both related and unrelated to ICT as well as more abstract innovations like business processes and business models.

■ Concluding discussion – Challenges ahead

In this paper we have enacted the Airport Living Lab in Stockholm as a focal point resulting in five propositions that should be on the agenda of research and implementation for Living Lab founders in the coming years.

The presented propositions can be grouped into three sets based on their underlying intentions for the Living Lab. The first three propositions (1-3) could be said to encapsulate an aspiration to increase the number of submitted problems/solutions. The propositions are based on innovation literature indicating the under-utilized role of staff outside the R&D departments, studies on incentives driving open source contributors, and literature on communities of practise supported by electronic collaboration tools. The fourth proposition (4) aims at increasing the efficiency for translating the submissions into implemented innovations. The proposition is based on experiences from business opportunity development processes through the entrepreneurial evaluation approach utilized by the VC industry. The last proposition (5) aims at providing a necessary widening of the scope of the Living Lab concept.

Coming back to the theoretical platform behind the Living Lab movement, the question of openness vs. closedness is relevant for all the stages and layers of the Living Lab approach and we see many challenges ahead in keeping the innovation as open as possible. With the assumption that open innovation provides a number of advantages over closed innovation, or at least that the Living Lab should adhere to the open innovation paradigm as closely as possible, there are challenges and traps in each stage where the process risk being closed up.

In line with the open innovation paradigm the ambition of the proposed Living Lab approach is to not exclude the "non-firm actors" (WEST &

LAKHANI, 2008) such as users in any of the stages. But the openness will vary as the innovation process progresses where e.g. the Business evaluation stage involves activities that are clearly closing up the process. It would be interesting to follow up on and experiment if we can open up e.g. the business evaluation stage for more user involvement than as proposed in the approach. Also the experimentation stage could end up closing unnecessarily when partners of the Living Lab start activating its R&D departments to tap into the innovation activities of the Living Lab. An alternative path to this as for business propositions related to software development would be to link the business evaluation stage directly into the Open Source community.

The question of openness vs. closedness also comes back in looking at how the partners of a Living Lab can get the most out of their Living Lab investment. Different partners will invariably have their own level of internal openness in innovation. Clearly a question outside the scope of this article but most probably crucial to the sustainability of a Living Lab is: How can the interfaces to and awareness of the Living Lab (relatively open innovation) be designed and improved from a stakeholders' (relatively closed innovation) perspective, so that the positive effects of the Living Lab reaches all the stakeholders? In short: How do we get the right people talking and how do we help companies to extend their strategies on how to capture the whole potential of Living Labs. How will exposure to and involvement with open innovation collaboration for a closed innovation stakeholder affect this stakeholder and change its innovation culture? Can the Living Lab mediate different levels of openness in innovation? How to combine open innovation and open infrastructures to possibly very closed industrial projects developed in these environments? Who owns the ideas and results?

Scholars have discussed ways of organizing innovation taking into consideration various internal tensions including to keep innovation options open versus commitment to well-defined innovation pathways (GHEMAWAT, 1991; FAEMS, VAN LOOY & DEBACKERE, 2005). We emphasize the possibility to see the Living Lab as a well-organized structure that can not only tap into the innovative energy of users, but also truly support inter-organizational collaboration. But if not handled pro-actively there may emerge friction among stakeholders due to a successful innovation outcome. So far this particular Living Lab has handled this potential risk through emphasizing early discussions among stakeholders on putting governance processes in place (illustrated by layer three in Figure 1), including various legal scenarios for commercialization. Can the Living Lab as a future organizational design provide a creative breathing space for

some innovation activities that have a hard time flourishing inside a Living Lab partner organization? If so, the Living Lab could for a firm become a flexible way of testing the open innovation paradigm while in orderly fashion re-organizing the firm's internal innovation activities.

Designing of human–computer interaction and interfaces brings along a set of its own questions. What is the optimal mix and design of electronic collaboration tools? How should the critical interfaces between the users and knowledge repositories in the Living Lab be designed? A strength of the Living Lab methodology is the possibility to gather user feedback with good timing, i.e. feedback in the specific context and close to the specific time that a user is exposed to a situation. This should not be underestimated and gives implications to constructions of channels. In the Airport environment we are looking into ways of cross-checking data on customer input time stamps and contextual data like flight delays. How do the electronic collaboration tools match the right timing to real-world environments? In short: How do we make user-collaboration easy to bring great ideas into the Living Lab?

IT is a substantial enabler for open innovation. The Internet opens up new collaboration channels due to its ubiquitous presence and changes the boundaries of the boxes in which we are innovating. The innovation taking place online, such as have been seen in this project, has become user-driven, continuous and geographically unbound. So far we are only observing the beginning of IT-tools designed specifically for open innovation. Up until now software developers have focused on the collection and evaluation of ideas from users, but with quite simple evaluation (voting) and collaboration (commenting) features.

There are several future potential IT-applications suited to open innovation that software developers should look into. For starters tools for helping users formulate problems/solutions in the first place and in that way spur creativity. Another suggestion based on our findings is providing enhanced administrative tools for increased interaction between different user groups – most predominantly staff and end-customers. This in order to get the dynamic discussion between experts and innovative crowds started. Better channels, also through mobile technology, for smoothly submitting ideas as well as enhancing later user collaboration are also welcomed.

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