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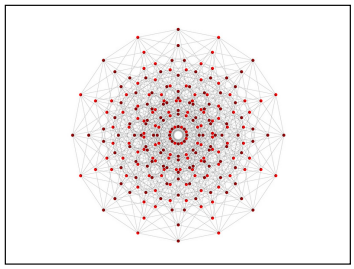

Living Labs

Welcome to the November 2013 issue of the *Technology Innovation Management Review*. This month's editorial theme is Living Labs. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview

The *Technology Innovation Management Review* (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints – from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others – to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

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Editorial: Living Labs

Chris McPhee, Editor-in-Chief
Seppo Leminen and Mika Westerlund, Guest Editors

From the Editor-in-Chief

Welcome to the November issue of the *Technology Innovation Management Review*. This month's theme is **Living Labs**, and it is my pleasure to welcome our guest editors, **Seppo Leminen**, Principal Lecturer at the Laurea University of Applied Sciences and Adjunct Professor in the School of Business at Aalto University in Finland, and **Mika Westerlund**, Assistant Professor at Carleton University's Sprott School of Business in Ottawa, Canada. In this issue, our guest editors revisit the theme we covered in our popular September 2012 issue on Living Labs (timreview.ca/issue/2012/september).

December's issue will include additional articles on the topics of living labs as well as crowdsourcing, along with a report on a recent TIM Lecture by **Stoyan Tanev**, Associate Professor in the Department of Technology and Innovation at the University of Southern Denmark, titled: "Technology Adoption by Design: Insights for Entrepreneurs". As I did last December, I will also list our most popular articles from the past year. In January, we present our annual issue on Open Source Business, which will be followed by an issue on Cybersecurity in February.

I am also pleased to announce the publication of our third ebook: *Value Co-Creation: Best of TIM Review* (tinyurl.com/lhy6w3k), which features 16 of the best articles from the TIM Review, selected and introduced by **Stoyan Tanev** and **Marko Seppä**. We are grateful to **Adam Chowaniec**, CEO of Amiga2, for contributing the insightful foreword to this third book in our series (timbooks.ca). Note that all of the net proceeds from the sales of these ebooks will be used to offset the operational costs of publishing the TIM Review, so we ask you to help spread the word within and beyond your networks. We hope you enjoy this issue of the TIM Review and will share your comments online. Please contact us (timreview.ca/contact) with article topics and submissions, suggestions for future themes, and any other feedback.

Chris McPhee
Editor-in-Chief

From the Guest Editors

We are pleased to introduce this issue on the theme of Living Labs. Since our first issue on this theme was published in September 2012 (timreview.ca/issue/2012/september), the concept of living labs has kept evolving and has become accepted by more and more practitioners and researchers.

Prior literature suggests several benefits for utilizing living labs. They have been proposed to catalyze regional systems of innovation, to strengthen the innovation capacity of organizations, to make innovation processes more effective, to cut innovation costs by sharing resources, to reduce market-based risk, and to enhance sustainable solution development. Living labs can be seen as the latest stage on a continuum of versatile forms of open and user innovation (cf. Leminen et al., 2012; timreview.ca/article/602). The topic deserves more attention because of the mounting interest in living labs from innovators and policymakers and due to the increasing role of users in contemporary innovation practices.

This issue of TIM Review provides five theoretically and practically oriented articles for managers and innovation developers as well as researchers and other parties of interest. The selected articles address living lab activities taking place today in different European countries and introduce a variety of perspectives, frameworks, and categorizations of the living lab phenomenon. In particular, the articles put forward five different perspectives on living labs: network, design, regional development, open innovation, and service. We encourage readers to perceive the provided views as globally beneficial ways of involving users in innovation rather than as the "European school" of living lab thinking.

The first article is by **Seppo Leminen**, who takes a network perspective and introduces a framework of innovation mechanisms in living labs. The framework builds on different coordination and participation approaches in living lab networks and provides evidence on their prevalence through cases from four countries. The article concludes by delivering opportunities for practitioners to enhance innovation in living labs and calls for more research on the longitudinal examination of living lab networks.

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The second article is by **Paula Femeniás** and **Pernilla Hagber**t from Chalmers University of Technology in Gothenburg, Sweden. They explore sustainable living in terms of reduced energy and resource use. The article assumes a design perspective and describes a first step towards a strategy for using living labs as a means to foster innovation and develop new concepts of sustainable living from an architectural point of view. The authors introduce Habitation Lab, a form of design studio for radical experimentation between different stakeholders in the context of architecture.

In the third article, **Soile Juujärvi** and **Kaija Pesso**, from Laurea University of Applied Sciences in Finland, take a regional development perspective and examine the characteristics and success factors of urban living labs based on a case study in Finland. City centres and neighbourhoods have increasingly been serving as regional living labs. This article takes the perspective of a regional innovation system in exploring the needs of urban residents. The authors reveal various actor roles and conclude that urban living labs require a long-term perspective to succeed.

In the fourth article, Dimitri Schuurman, Lieven De Marez, and **Pieter Ballon**, from the iMinds Media & ICT research group in Belgium, adopt the open innovation perspective to analyze knowledge spill-overs between actors in living labs. The article is based on case studies from a living lab in Belgium. It makes a significant contribution to the discussion on the role of three open innovation processes in living labs: exploration, exploitation, and retention. Finally, a concrete set of guidelines is proposed to foster innovation in living labs.

The fifth article is by **Anna Ståhlbröst** from Luleå University of Technology, Sweden, who provides a service perspective on innovation in living labs. Her research is grounded by interviews with micro-enterprises that have utilized living lab services to ideate, create, and test innovations. The author highlights the benefits of living lab services and collaboration for small firms that lack resources. The study puts forward that using a living lab as a service can generate three types of value: improved innovations, the role the living lab can play, and the support the living lab offers.

Taken together, we hope that the diverse perspectives offered in these articles will help you better understand the phenomenon of living labs and realize its benefits in your own organization.

Seppo Leminen and Mika Westerlund, Guest Editors

About the Editors

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. Chris holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa and BScH and MSc degrees in Biology from Queen's University in Kingston. He has over 15 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

Seppo Leminen holds positions as Principal Lecturer at the Laurea University of Applied Sciences and Adjunct Professor in the School of Business at Aalto University in Finland. He holds a doctoral degree in Marketing from the Hanken School of Economics and a licentiate degree in Information Technology from the Helsinki University of Technology (now the School of Electrical Engineering at Aalto University). His doctoral research focused on perceived differences and gaps in buyer-seller relationships in the telecommunication industry. His research and consulting interests include living labs, open innovation, value co-creation and capture with users, neuromarketing, relationships, services, and business models in marketing as well as management models in high-tech and service-intensive industries.

Mika Westerlund, D. Sc. (Econ.) is an Assistant Professor at Carleton University's Sprott School of Business in Ottawa, Canada. He previously held positions as a Postdoctoral Scholar in the Haas School of Business at the University of California Berkeley and in the School of Economics at Aalto University. Mika earned his doctoral degree in Marketing from the Helsinki School of Economics. His current research interests include open innovation, business strategy, and management models in high-tech and service-intensive industries.

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Keywords: living labs, networks, design, regional development, open innovation, services

Coordination and Participation in Living Lab Networks

Seppo Leminen

> *"To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science."*
>
> Albert Einstein (1879–1955)
> Theoretical physicist and Nobel laureate (1921)

Previous research on living labs has emphasized the importance of users and a real-life environment. However, the existing scholarly discourse lacks understanding of innovation mechanisms in diverse living lab networks, especially from the perspectives of coordination and participation. This study addresses the research gaps by constructing a framework for analyzing coordination (i.e., top-down versus bottom-up) and participation (i.e., inhalation-dominated versus exhalation-dominated) approaches in living lab networks. The classification is based on a literature review and an analysis of 26 living labs in four countries. Given that inhalation and exhalation dominance have not been discussed previously in the innovation literature, the study provides novel ways for both scholars and managers wishing to exploit or explore innovations in living labs. The framework reveals the opportunities for practitioners of innovation with respect to coordination and participation in living lab networks.

Introduction

Familiarity with user requirements and preferences is a prerequisite for companies and organizations. Engaging users as a part of innovation has been shown to increase company performance across various industries (Edvardsson et al., 2010; tinyurl.com/3exkqua). Engaging and involving customers and users as co-developers of innovation strengthen that trend; users participate in many ways to develop brands, experiences, designs, marketing strategies, products, and services (Jeppesen and Molin, 2003: tinyurl.com/k2h6o4r; Zwick et al., 2008: tinyurl.com/mp9hxk7).

Huizingh (2011; tinyurl.com/kfqyd4l) provides an overview of open innovation and calls for more research on conceptual clarification. Living labs, as an emerging mode of open innovation, have attracted the research community (Almirall and Wareham, 2011; tinyurl.com/lrz3dg2). Almirall, Lee, and Wareham (2012; timreview.ca/article/603) outline the characteristics of living labs in terms of user involvement, operation in real-life contexts, and public-private partnerships. Similar to other innovation networks, living labs have been shown to cover various innovation activities and lead to diverse outcomes (Pittaway et al., 2004: tinyurl.com/mdfaap5; Almirall and Wareham, 2011: tinyurl.com/lrz3dg2; Leminen et al., 2012: timreview.ca/article/602). As one form of open innovation network, living labs contain four types of key actors: users, providers, utilizers, and enablers (Westerlund and Leminen, 2011; timreview.ca/article/489).

Living labs stress the importance of users in innovation activities, and their roles are widening from passive informants into co-creators (Leminen, Westerlund, and Nyström, 2014: forthcoming in Volume 9 (Issue 1) of the *International Journal of Technology Marketing*; tinyurl.com/mdug2zv). The diversity of roles played by users and other stakeholders reflects the spectrum of living lab networks (Nyström, Leminen, Westerlund, and Kortelainen, 2014: forthcoming in *Industrial Marketing Management*; tinyurl.com/bwmn2vy). Furthermore,

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Leminen, Westerlund, and Nyström (2012; timreview.ca/article/602) argue that living lab networks are characterized by the type of actor that is driving the innovation and the mechanisms by which the actors' goals are achieved. Despite the growing interest and attempts to distinguish the various types of living labs, their underlying innovation mechanisms and their link with the party driving the innovation in living lab networks need more research (cf. Følstad, 2008: tinyurl.com/m9wa2dc; Dutilleul et al., 2010; tinyurl.com/k3v3yzo). Therefore, this study aims at understanding innovation mechanisms in living labs. The research questions are as follows:

1. *What are the different coordination and participation approaches in living lab networks?*

2. *How are these approaches linked to diverse living lab networks?*

The article is organized into three main sections. In the first section, it reviews the theoretical foundations of living labs and discusses coordination approaches in term of two opposing forms of coordination: top-down and bottom-up. Next, it describes the research methodology including data collection and analysis. In the third section, the article summarizes findings and reports on two participation approaches (i.e., inhalation-dominated and exhalation-dominated) to innovation based on the analyzed cases. The article concludes by constructing a framework for understanding innovation in living labs, including the dimensions of coordination approach and participation approach.

Living Labs as Open Innovation Networks

According to Følstad (2008; tinyurl.com/m9wa2dc) and Dutilleul, Birrer, and Mensink (2010; tinyurl.com/k3v3yzo), living labs are grounded on diverse assumptions. These assumptions give rise to open innovation management and the innovation approaches in living labs. Prior research has explored living labs from diverse perspectives including socio-technological systems (Budweg et al., 2011; tinyurl.com/8u3yhvv), ICT innovation development (Følstad, 2008; tinyurl.com/m9wa2dc), operations and functions (Almirall and Wareham, 2011; tinyurl.com/lrz3dg2), processes (Katzy et al., 2012; tinyurl.com/lvroe2d), social constructions (Dutilleul et al., 2010; tinyurl.com/k3v3yzo), methodologies (Almirall et al., 2012: timreview.ca/article/603; Schuurman and De Marez, 2012: timreview.ca/article/606; Mulder, 2012: timreview.ca/article/607), key principles (Ståhlbröst, 2012; tinyurl.com/l8ur4cu), motivation (Ståhlbröst and Bergvall-Kåreborn, 2011; tinyurl.com/ll2sy7k), user roles (Leminen, Westerlund, and Nyström, 2014: forthcoming in Volume 9 (Issue 1) of the *International Journal of Technology Marketing*; tinyurl.com/lqt93mm), and actors' role patterns (Nyström, Leminen, Westerlund, and Kortelainen, 2014: forthcoming in *Industrial Marketing Management*; tinyurl.com/kn63gxw).

According to Dutilleul, Birrer, and Mensink (2010; tinyurl.com/k3v3yzo), the term "living lab" has diverse meanings. It can refer to: i) an innovation system; ii) experimentation of a technology; iii) involving users in the product development process; iv) organizations facilitating the network and offering relevant services; or v) the European living lab movement. Living labs are grounded on real-life contexts, user involvement, and public-private partnership (Almirall et al., 2012; timreview.ca/article/603). In fact, Ballon, Pierson, and Delaere (2005; tinyurl.com/8hox58r) differentiate between living labs in real-life environments from test beds in controlled laboratory environments. A user is an object to be studied in a test bed, whereas in a living lab, the user acts as a subject, is an equal co-creator, and adopts more versatile roles (Ballon et al., 2005: tinyurl.com/8hox58r; Leminen and Westerlund, 2012; tinyurl.com/orlnfh5).

Almirall and Wareham (2011; tinyurl.com/lrz3dg2) argue that a living lab acts as an intermediary between various actors. Dutilleul, Birrer, and Mensink (2010; tinyurl.com/k3v3yzo) propose that living labs form a central point for innovation in multi-organizational collaboration. Westerlund and Leminen (2011; timreview.ca/article/489) identify distinct actors in living labs: providers, users, utilizers, and enablers. These groups of actors form a core of roles that are adapted and changed based on selected operations and desired outcome (Nyström, Leminen, Westerlund, and Kortelainen, 2014: forthcoming in *Industrial Marketing Management*; tinyurl.com/kn63gxw). A living lab supports collaboration and knowledge exchange between actors and acts as a platform for stimulating both the shared goal of the living lab and the goals of individual actors (Leminen and Westerlund, 2012; tinyurl.com/orlnfh5). According to Stewart (2007; tinyurl.com/6cx2pfb) and Leminen and colleagues (2011; tinyurl.com/n3tfz2a), living labs can be categorized by the driving actor in a network.

To sum up, prior research lacks a consistent definition for living labs and related constructs. The literature on living labs shares the view that living labs refer to real-life environments and the "living lab approach" is embedded in living labs. The literature provides differing views of living lab approaches; most authors identify various actors and stress the importance of users (Eriks-

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son et al., 2005: tinyurl.com/8fv3jkp; Ballon et al., 2005: tinyurl.com/8hox58r; Westerlund and Leminen, 2011: timreview.ca/article/489). However, the diverse roles of stakeholders in living labs are under-researched (Nyström, Leminen, Westerlund, and Kortelainen, 2014: forthcoming in *Industrial Marketing Management*; tinyurl.com/kn63gxw). Some scholars view the approach as activities conducted at living labs (de Leon et al., 2006; tinyurl.com/lloveun) and emphasize the resources of actors in living labs (Leminen and Westerlund, 2012; tinyurl.com/orlnfh5). Thus, actors, activity, and resources can be seen as key elements of living lab networks. Such networks have been discussed as open innovation intermediaries (Almirall and Wareham, 2011; tinyurl.com/lrz3dg2), innovation networks (Leminen and Westerlund, 2012; tinyurl.com/orlnfh5), milieus (Bergvall-Kåreborn et al., 2009; tinyurl.com/m6kn9mu), innovation environments (Mulder and Stappers, 2009; tinyurl.com/9f75ndh), networks of rural development (Schaffers and Kulkki, 2007; tinyurl.com/mplfq9e), and networks of living labs as the innovation system (Dutilleul et al., 2010; tinyurl.com/k3v3yzo). Table 1 summarizes the characteristics and definitions of living labs from different perspectives.

In accordance with Westerlund and Leminen (2011; timreview.ca/article/489), this study defines living labs as "physical regions or virtual realities, or interaction spaces, in which stakeholders form public-private-people partnerships (4Ps) of companies, public agencies, universities, users, and other stakeholders, all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts."

Top-down and Bottom-up Approaches

Sabatier (1986; tinyurl.com/l9o9az9) reviewed literature about bottom-up and top-down approaches in public policy making and concluded that the two approaches have different features and are applicable in different situations. To simplify these approaches, a top-down approach is merely led or coordinated to accomplish centralized and official targets, whereas a bottom-up approach operates at the grassroots level and focuses on local needs. Sabatier argues that the bottom-up and top-down approaches often ignore the benefits of their opposite approaches; for example a formal strategy is not described in a bottom-up approach and a top-down approach often ignores the local needs of the many different participants.

Oxford English Dictionary (oed.com) defines top-down as "something that proceeds from the top downwards; authoritarian, hierarchical". At least two hierarchy types may be found to describe top-down and bottom-up in literature. The first hierarchy type is an authority structure, such as Weber's (1947; tinyurl.com/kreh7js) bureaucracy, where individuals at higher levels of the hierarchy have authority over individuals at lower levels. The second hierarchy type is a parts-within-parts containment structure, such as that of Simon (1962; tinyurl.com/jvhfwd5), where higher-level constructs (e.g., companies) are composed of lower level constructs (e.g., people). However, this article takes a different view; because living labs are facilitated rather than managed, they have no authority over individuals (Westerlund and Leminen, 2011; timreview.ca/article/489) and important roles of users are widely accepted. Opposite to the two previously identified hierarchy types, this study defines hierarchy as an innovation-facilitation mechanism to facilitate progress towards a given target. Consequently, this article defines a top-down approach in living labs as an authoritarian, hierarchical innovation approach that is directed, controlled, and proceeds from top to bottom when creating, prototyping, validating, and testing new technologies, services, products, and systems in real-life contexts. The opposite approach, a bottom-up approach in living labs, refers to an innovation approach in which emergent, grassroots ideas and needs are collectively developed, created, prototyped, and validated for mutual and shared objectives, new services, products, systems, and technologies in real-life contexts.

The open innovation literature provides various classifications of open innovation and openness. For instance, Bogers and West (2012; tinyurl.com/ba3gg3x) contrast and classify the concepts of open innovation (Chesbrough, 2003; tinyurl.com/nxupq2q) and user innovation (von Hippel, 2007; tinyurl.com/ohwh2fp). The classification does not explicitly address the top-down and bottom-approaches but implicitly depicts them. Chesbrough (2003; tinyurl.com/nxupq2q) submits that open innovation is a way for management innovation from a company perspective. This approach may be called company-led or top-down. Conversely, von Hippel (2007; tinyurl.com/ohwh2fp) puts forward that users or user communities solve their needs with the help of open innovation. This approach is community-led or bottom-up.

This study views bottom-up and top-down as the opposite ends of the coordination approach in living labs.

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Table 1. Different perspectives on living labs

Characteristics	Definition	Examples
• Real-life environment • Multi-stakeholder approach: users, public, firms, and academia • Multi-contextual • User as innovator	An R&D methodology to create and validate in a collaborative, multi-contextual, empirical real-world environment, with users playing a central role as innovators	Eriksson, Niitamo, & Kulkki (2005) tinyurl.com/8fv3jkp
• Openness • Public involvement • Commercial maturity • Vertical scope • Scale • Duration	"An experimentation environment in which technology is given shape in real-life contexts and in which (end) users are considered 'co-producers'" p. 5	Ballon et al. (2005) tinyurl.com/8hox58r
• R&D methodology • User-centred, real-life approach • Collaborative multi-contextual environments • Design, test, validate and develop • Co-creation by real consumer and end users • Living lab network	"An R&D methodology where innovations, such as new services, products, or applications enhancements, are created and validated in collaborative, multi-contextual, empirical, real-world environments within individual regions" p. 1	de Leon et al. (2006) tinyurl.com/lloveun
• Experimentation and validation environments • User centric • Catalyze rural and regional systems of innovations • Cooperation between users, technology, and application • Network of rural living labs	"As experimentation and validation environments characterized by early involvement of user communities, closely working together with developers and other stakeholders, and driving rapid cycles of ICT-based innovations" p.31	Schaffers & Kulkki (2007) tinyurl.com/mplfq9e
• Milieu (environment, arena) • Approach (methodology, innovation approach)	"A user-centric innovation milieu built on every-day practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values" p.3	Bergvall-Kåreborn et al. (2009) tinyurl.com/m6kn9mu
• Innovation environment • Real-life setting • User-driven • Living lab network	"Not a network of infrastructure and services" but also "a living network of real people with rich experiences."	Mulder & Stappers (2009) tinyurl.com/9f75ndh
• Network of living labs as an innovation system • Multi-stakeholder • Contact, communication, and collaboration	A social configuration that is organized for innovation creation by contact, communication, and collaboration.	Dutilleul et al. (2010) tinyurl.com/k3v3yzo
• Open innovation intermediary • Exploration and exploitation • Innovation types and outcomes	"Open innovation intermediaries that seek to mediate between users, research, and public and private organizations, [and to] advance our concept of technology transfer by incorporating not only the user-based experimentation, but also by engaging firms and public organizations in a process of learning and the creation of pre-commercial demand" p. 100	Almirall & Wareham (2011) tinyurl.com/lrz3dg2
• Multi-stakeholder approach; user, provider, enabler, and utilizer • A form of open innovation • Co-creation with users	As "experimentation environments; they are physical regions or virtual realities where 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" p. 20	Westerlund & Leminen (2011) timreview.ca/article/489
• Multi-actor innovation network • Role, resource, objective, motivation, and outcome	As a multi-actor innovation network that "employs heterogeneous roles and resources", "shares information to enable flexibility", "reveals undefined and latent needs", and where the "lack of strict objectives guides collaboration and outcomes".	Leminen & Westerlund (2012) tinyurl.com/orlnfh5

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In the following sections, the study depicts how previous research on living labs distinguishes these two opposite ends and their combinations. For example, Pascau and van Lieshout (2009; tinyurl.com/cmrkjlw) found that living labs involve bottom-up activities rather than top-down control. Følstad (2008; tinyurl.com/m9wa2dc) and Schuurman and colleagues (2011; tinyurl.com/lj39xsk) propose "bottom-up" as a construct consisting of nine characteristics for describing living labs. Furthermore, Budweg and colleagues (2011; tinyurl.com/8u3yhvv) argue that a top-down approach is linked to the structure and mechanism for managing technology adaptions in organizational settings within living labs, whereas a bottom-up approach is a tool for adaption opportunities as well as a strategy and a process for local stakeholders.

Leminen and colleagues (2011; tinyurl.com/n3tfz2a) propose that top-down and bottom-up are principles for innovation development in living labs networks. Moreover, Leminen, Westerlund, and Nyström (2012; timreview.ca/article/602) argue that a top-down approach is a principle for managing innovation development in an open innovation network, whereas a bottom-up approach is a principle for facilitating innovation development in networks. Lievens and colleagues (2011; tinyurl.com/mgcxfap) view living labs as a combination of bottom-up and top-down development; whereas a bottom-up approach is a source for needs and requirements, a top-down approach acts as need validation for ideas and concepts. Furthermore, Sauer (2012; tinyurl.com/om2e6gg) identifies the need for integration of bottom-up approach as a source of unanticipated ideas and top-down approach as a formal structure for living labs. Finally, Tang and colleagues (2012; tinyurl.com/kygmlmu) propose a duality model of a living lab that integrates both company-led innovation and a grassroots innovation model (i.e., top-down and bottom-up approaches). Table 2 summarizes previous research and identifies the characteristics of top-down and bottom-up approaches in living lab research.

To sum up, the current literature on living labs distinguishes two diverse streams on coordination in open innovation networks. The first stream assumes that the network is coordinated by the needs and wishes of a single party. It further assumes that innovation is driven by an individual actor in an open network and takes either a top-down or bottom-approach. The second stream assumes that innovation development in open innovation networks takes place in combination with both top-down and bottom-up approaches. This synthesis may be found in innovation networks with multiple actors such as in living labs. This study applies the first literature stream on coordination; the second stream fails to address that an innovation network is driven by a single actor and that all actors may have goals of their own as well as shared goals (Leminen and Westerlund, 2012; tinyurl.com/orlnfh5).

Methodology

This study employed a qualitative research approach in analyzing 26 living labs in four countries: Finland, South Africa, Spain, and Sweden. These countries were chosen because of their diversity and number of living labs and their leading-edge positions of establishing living lab networks (European Network of Living Labs, 2012; enoll.org). There is a good potential for transferability of findings because this sample can be considered representative of countries having existing living labs. The cases were selected according to following criteria: i) each case must apply a living labs approach based on open innovation initiatives; ii) each case must include the development of a new product/service, a business concept, or social innovation with multiple actors; and iii) each case must involve users, user groups, or a user community in their everyday life or a simulation.

The data was collected between 2008 and 2011, and included interviews with 103 participants from living labs. The purpose of the interviews was to increase the understanding of innovation mechanisms in living labs. The interviews were carried out as face-to-face discussions, which lasted typically between 60 to 90 minutes. Primary data informants were CEOs, CTOs, sales directors, project managers, researchers, project coordinators, and users. Core actors were selected in every living lab, because not all stakeholders could be interviewed in each living lab. The interviews covered themes such as background information, organizing the living lab, actualizing the living lab, and as well as results and outcomes of innovation in living labs.

Websites, bulletins, magazines, and case reports comprised the secondary data source for the study. In the first phase, the empirical data was systematized according to living lab, date of interview, and type of informant. This study analyzed and coded actors and driving actors from transcribed interview data without prior assumptions about actors (i.e., using open coding). Then, this study applied focused coding: the explored categorization was compared to the conceptualization of driven actors by Leminen, Westerlund, and Nyström (2012; timreview.ca/article/602).

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Table 2. Top-down and bottom-up approaches in prior literature on living labs

Construct	Definition of construct	Sources
Top-down	Top-down as a structure and mechanism for managing technology adaptations in an organizational setting	Budweg et al. (2011) tinyurl.com/8u3yhvv
	Top-down as a need validation in experimental situations	Lievens et al. (2011) tinyurl.com/le8xfuc
	Top-down as a principle for innovation development	Leminen et al. (2011) tinyurl.com/n3tfz2a
	Top-down as a principle for managing innovation development in networks	Leminen et al. (2012) timreview.ca/article/602
	Top-down as a company-led innovation model	Tang et al. (2012) tinyurl.com/kygmlmu
Bottom-up	Bottom-up as a construct of nine characteristics for describing living labs	Følstad (2008) tinyurl.com/m9wa2dc Schuurman et al. (2011) tinyurl.com/lj39xsk
	Bottom-up as user´s role in innovation process	Pascau & van Lieshout (2009) tinyurl.com/cmrkjlw
	Bottom-up as a tool for adaption opportunities for local stakeholders as well as strategy and process	Budweg et al. (2011) tinyurl.com/8u3yhvv
	Bottom-up as a source of needs and requirements	Lievens et al. (2011) tinyurl.com/le8xfuc
	Bottom-up as a principle for innovation development	Leminen et al. (2011) tinyurl.com/n3tfz2a
	Bottom-up as a principle for facilitating innovation development in networks	Leminen et al. (2012) timreview.ca/article/602
	Bottom-up as grassroots innovation for communities	Tang et al. (2012) tinyurl.com/kygmlmu

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In the third phase, this study investigated thoroughly each living lab case to describe the coordination approach and compare it to Sabatier's (1986; tinyurl.com/l9o9az9) typology. In the fourth phase, this study detected previously unknown participation approaches ("inhalation dominated" versus "exhalation dominated") to distinguish innovation in living labs based on case analysis. Finally, this study synthesized the results and concluded by describing the coordination approach and participation approach. Table 3 synthesizes the data analysis process and its phases.

Findings

Based on the analysis, this study developed the framework shown in Figure 1. The framework forms a matrix of innovation mechanisms in living lab networks and thereby illustrates a coordination approach ("top-down" versus "bottom-up") and a participation approach ("exhalation-dominated" versus "inhalation-dominated") with four previously identified types of living lab network options (Leminen et al., 2012; timreview.ca/article/602). The first dimension is grounded on the coordination of innovation activities or initiatives in living lab networks. Innovation activities take place either through a top-down approach or a bottom–up approach (Sabatier, 1986; tinyurl.com/l9o9az9).

The second dimension is the previously unknown participation approach to innovation, which was detected based on the case analysis. This study distinguishes the participation approach and its two extremes: exhalation dominated and inhalation dominated. The study proposes that the inhalation-dominated innovation approach, or "out-in approach", is initiated and targeted at fulfilling the needs of a driving party by engaging other stakeholders in innovation activities. This approach encourages parties to bring their knowledge, expertise, and resources into the open innovation network. The exhalation-dominated innovation approach, or "in-out approach", does not primarily fulfill a need of the driving actor, but rather the requirements and wishes of other stakeholders. This approach engages stakeholders for collective action in the open innovation network. This study stresses that the "out-in approach" and the "in-out

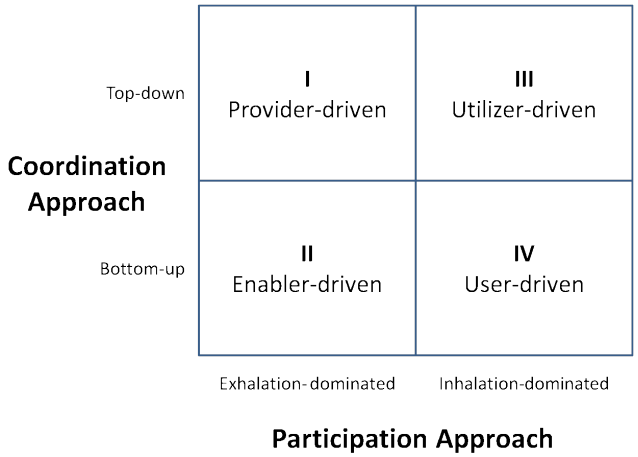

Figure 1. A matrix of innovation mechanisms in living lab networks

Table 3. Data analysis process

Data Analysis Phases	Task	Outcome
1. Open coding	• Organize living lab cases • Identify actors in each case	Overview of living lab cases
2. Focused coding	• Identify the driving actor in each living lab	Determination of the driving actor (Leminen et al., 2012) in each living lab case
3. Focused coding	• Identify and analyze coordination approach • Compare data to theory	Classification of coordination approaches based on Sabatier (1986)
4. Identifying innovation in living lab networks	• Identify for whom innovation activities are conducted	Detection of previously unknown participation approach to innovation
5. Theorizing the codes	• Synthesize phases 1 to 4	Findings and results on innovation development in living labs

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approach" are dissimilar to earlier open innovation concepts of "in-side out" and "out-side in", given that the inside-out concept refers to the commercialization of ideas and technology and the outside-in concept refers to the acquisition and sourcing of external knowledge for a company (Enkel et al., 2009; tinyurl.com/mspeap8).

Figure 1 synthesizes the results from the analysis in living labs. It illustrates four different types of living lab networks and shows the dependencies of coordination and participation approaches in these networks. The framework is considered a key outcome of this study because inhalation- and exhalation-dominated innovation have not been discussed in prior innovation literature.

All four types of living lab networks typically include similar actor roles: user, utilizer, provider, and enabler. However, the networks differ by: i) the driving party (i.e., a living lab stakeholder who leads the innovation activities); ii) coordination of innovation; and iii) participation in those networks. Provider-driven and utilizer-driven living labs are top-down coordinated, which mean that innovation activities are typically directed and controlled from the top downward. In contrast, user-driven and enabler-driven living labs are characterized by bottom-up coordination of the development, creation, and validation of ideas at the grassroots level.

Both provider-driven and enabler-driven living labs were associated with exhalation dominance as their participation approach, which is the second outcome of this study. A provider-driven living lab (i.e., model 1, as depicted in the top-left corner of Figure 1) has multiple tasks. The living lab is used, for example, to offer services to the utilizers, to offer solutions to the needs of other stakeholders, or to educate students as a part of research project in living labs. The following quotes from the interviews exemplify the exhalation-dominated approach.

As the CEO of a provider-driven living lab in Finland explained:

"We have been talking with a food company. They were very interested in doing the ideation process with us on... let's say, what the future of eating is. How people are going to eat in the future, what you are going to cook, and how you are going to consume it are, of course, heavily influenced by the means you have to make it… You can imagine that, by doing such an analysis with them, you will get ideas on whom we should have around the table to have the right ideas about the future of eating."

On the other hand, an enabler-driven living lab (i.e., model II, as depicted in the bottom-left corner of Figure 1) collects development needs from the region, its associations, its occupants, and its user communities; in other words, it follows a bottom-up approach. It also offers to provide outcomes for these needs, and is therefore exhalation dominated. Typically, an enabler-driven living lab creates activities to serve and improve living conditions of citizens and communities in a geographically restricted area. For instance, the Director of an enabler-driven living lab in Spain described:

"We want to develop a project to help to people with mental and physical handicaps or disease. The reason is that we want to let these people live wherever they want, even in rural areas, because for some things they have to go to big cities to receive [services, facilities]… and because of this project, the people receive the services or the facilities they need without moving, without the obligation to move to... see other, if in other places there are facilities to reach these objectives."

The analysis of this study links utilizer-driven and user-driven living labs to the inhalation-dominated approach to participation, which is the third key result of this study. Both provider-driven and enabler-driven were associated with exhalation dominance in the participation approach.

In a utilizer-driven living lab, innovation activities are typically directed, controlled, and initiated from the top downward, and follow an exhalation-dominated approach, and the innovation activities are conducted to meet the needs of the utilizers. In other words, a utilizer typically uses a living lab as a mechanism and resource spring to develop and create new ideas, concepts, or prototypes or to validate and test concepts, products, and services. Consider the following quote from a Project Manager from a utilizer-driven living lab in Finland:

"Living labs, from my point of view, are controlled environments in which real users can evaluate and test early prototypes or work-in-progress products and services. [In those controlled environments] we can observe them, and we can collect feedback from them, and identify problems and development needs."

In contrast, a user-driven living lab is based on an assumption that development needs come from individual users or a user community (i.e., bottom-up), and results or findings of innovation activities are delivered for the need of the users or user community (i.e., inhalation-dominated). A user-driven living lab (i.e., model IV, as depicted in the bottom-right corner of Figure 1) focuses on improving the everyday life conditions or

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activities of its users. For example, as described by the manager of a user-driven living lab in Sweden:

"We pay some extra attention to them. And when we work with them, they have ideas that they want, for example, to produce music. They want to do hip hop in new ways. They want to have a music club where something exciting is happening. Or they want to share their music. So, what we try to do is connect technology and ideas that could help them spread word about the music. Help them make exciting things happen in their club. So, they are doing this because we are helping them improve their everyday activities. So, it is important that it makes sense to them. It must make sense to them; it must be meaningful to them, to participate in experiments."

Conclusion

This research focused on understanding the coordination and participation approaches in living lab networks. The study highlighted three main results. First, the study introduced a framework in the form of an innovation-mechanism matrix to identify and analyze distinct living lab networks. The framework was grounded on two dimensions: coordination approach ("top-down" versus "bottom-up") and participation approach ("inhalation-dominated" versus "exhalation-dominated"). Inhalation and exhalation dominance have not been discussed in prior innovation literature. These two approaches are important for living lab research: coordination and participation approaches enable researchers to distinguish different types of living lab networks, which is still an under-researched topic in the domain of living labs. This study also propose that coordination and participation approaches may have broader applicability for other forms of open innovation, where the current classification literature (e.g., Bogers and West, 2010: tinyurl.com/ba3gg3x; Dahlander and Gann, 2010: tinyurl.com/chacrs9; Huizingh, 2011: tinyurl.com/kfqyd4l) does not cover these approaches. Second, the provider-driven and enabler-driven living labs are identified exhibit exhalation dominance in their participation approach. Third, the utilizer-driven and user-driven living labs are associated with inhalation-dominance in their participation approach.

This study addressed four previously identified types of living labs (cf. Leminen et al., 2012; timreview.ca/article/602) and explained their coordination and participation approaches using empirical data from a number of living labs as evidence. For managers, the study provides a framework – a practical tool – for depicting different living lab approaches. The results enable managers to pursue innovation development with open innovation communities by focusing on the variety of coordination and participation approaches in diverse open innovation networks.

There are always limitations in research. Extensive data was collected from a number of actors and living labs, but the interviews only covered a limited number of labs over a short time span. Prior research on living labs proposes the need for iterative initiatives (e.g., Schuurman et al., 2011; tinyurl.com/lj39xsk). Therefore, it would helpful expand the duration of the study and include multiple projects and initiatives within each living lab. Acknowledging these limitations, this study calls for more research on the longitudinal perspective of living labs and other open innovation networks. More specifically, new research questions may be articulated: "Can a different actor drive innovation in a subsequent case at the same living lab?"If so, how does a change of the driving actor affect the coordination and participation approaches to innovation?

Recommended Reading

- "Incremental and Radical Service Innovation in Living Labs" (Leminen and Westerlund, 2013; tinyurl.com/n32nlsx)

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About the Author

Seppo Leminen holds positions as Principal Lecturer at the Laurea University of Applied Sciences and Adjunct Professor in the School of Business at Aalto University in Finland. He holds a doctoral degree in Marketing from the Hanken School of Economics and a licentiate degree in Information Technology from the Helsinki University of Technology (now the School of Electrical Engineering at Aalto University). His doctoral research focused on perceived differences and gaps in buyer-seller relationships in the telecommunication industry. His research and consulting interests include living labs, open innovation, value co-creation and capture with users, neuromarketing, relationships, services, and business models in marketing as well as management models in high-tech and service-intensive industries. Results from his research have been reported in numerous scholarly journals, including *Management Decision*, the *International Journal of Product Development*, and the *Technology Innovation Management Review*, among many others.

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> *"We shape our buildings; thereafter they shape us."*
>
> Sir Winston Churchill (1874–1965)
> Prime Minister of the United Kingdom

This article describes a first step towards a strategy for using living labs as a means to foster innovation and develop new concepts of sustainable living from an architectural point of view. The overall aim is to enable truly sustainable living through radically reduced energy and resource use thus addressing both environmental and social aspects of sustainability. Earlier research has shown that contemporary housing developments, including those with a sustainable profile, do not profoundly question modern lifestyles and consumption, which is a necessity to overcome limitations of a technological focus on environmental efficiency in construction. Thus, we see an opportunity for the discipline of architecture to engage in current investments in living lab facilities in order to push innovation in the field of sustainable housing.

We introduce the concept of a "Habitation Lab", which will provide an arena for radical and high-risk design experimentation between users, building-sector actors, and academia, and we describe a case study of a planned Habitation Lab within a living lab facility where traditional solutions for daily living and habitation are questioned and new architectural innovations are explored and evaluated. The idea of using experimental activities in the field of housing is not new, and we argue that new investments should build on earlier experiences to avoid perpetuating misconceptions and repeating past failures. Furthermore, to ensure the dissemination and uptake of results, the design of the Habitation Lab should consider the innovation and learning trajectories of the building sector. We propose a transdisciplinary setting to provide a neutral arena for value creation and to increase the distribution of experiences.

Introduction

Sustainability and energy efficiency are areas that drive much of the building-related innovation at present. In Sweden, there has been a rapid development in low-energy construction (Femenías and Kadefors, 2011; tinyurl.com/mfx9aqz), but alternative concepts for the design and layout of dwellings and homes that enable changes in priorities and lifestyles have not been subject to the same development and still signify a more radical change of mindset (Hagbert et al., 2013; tinyurl.com/l5hgwct). Nevertheless, home-related resource use has been identified as a factor that largely contributes to the overall environmental impact of human actions, and should set living in the centre of attention for sustainable societal development. The standards and designs of dwellings are determined by norms within the sector, market surveys mapping customers' "willingness to pay", and regulations; however, these factors do not sufficiently reflect the urgency of our need to reduce energy and resource use. For instance, very little has changed regarding the standard of Swedish housing since the early post-war era. Even less effort has been made to adapt to a growing awareness of the environmental and social impact of the built environment, and the necessity to transition from the resource-intensive lifestyles perpetuated during the mid- and late 20th century.

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In this article, we explore the use of living labs as a means of fostering innovation and contributing to the development of new frames of reference focusing on the building sector and architectural practices. We introduce the concept of a "Habitation Lab" set up as a transdisciplinary innovation arena in which concepts relating to architecture and the use of space are questioned and explored. The aim for the Habitation Lab is to radically rethink the way we live, thus filling a gap where contemporary, market-driven innovation in housing fails to address fundamental questions for sustainable development. Drawing on the collaborative and user-centred principles of recent definitions of living labs (e.g., Bergvall-Kåreborn et al., 2009: tinyurl.com/m6kn9mu; McPhee et al., 2012: timreview.ca/article/601; Leminen and Westerlund, 2012: tinyurl.com/orlnfh5), the Habitation Lab is an innovation platform that emphasizes co-creation and learning between end users, partners in the building industry and related areas, academia (e.g., researchers and students from architecture and other disciplines), and, by extension, governmental bodies (e.g., planning officials and policy makers). The long-term aim is to achieve viable change by supporting innovation and learning among participants, both on professional and personal levels.

In order to induce change, the Habitation Lab has to relate to the context of development as well as change processes in the building sector. Furthermore, we should build on earlier knowledge of innovation in housing and construction when setting up experiments in the lab in order avoid “re-inventing the wheel”, perpetuating misconceptions, or repeating past failures. Consequently, in this article, we review earlier experimental activities related to housing in Sweden and briefly describe the main factors relating to innovation in construction. Next, we describe a design approach to living labs for habitation and present a case study of a Habitation Lab within a planned, purpose-built living lab, in the form of a design studio for architectural exploration. We next describe a plan for defining the types of exploration and experimentation that will be carried out in the Habitation Lab. Finally, we offer conclusions and describe the next steps for our research and for collaborations within a broader setting of a living lab.

Earlier Experiences from Building Experiments in Sweden

Knowledge in architectural design and construction is based on practical experiences built up in a slow process and throughout history. The introduction of new concepts, products, systems, or processes, responding to changing technical, market, or societal conditions, has often been approached by experimentation in order to speed up innovation and learning.

Conducting explicit experiments is not new to the industry. Bröchner and Månsson (1997; tinyurl.com/m5ucyty) report on what may be the first governmentally granted experiment with a tiled stove, which was found to halve the use of wood in Stockholm castle during the winter of 1766. Since the last century, targeted funding has been given to full-scale building experiments driven by specific challenges of the time. In the aftermaths of the 1970s oil crises, experiments and demonstrations were conducted with the aim of finding solutions that reduce energy use and oil dependence. Another main area for post-war experimentation has been industrialized production in construction. During the 1980s, participatory design was one track for development, together with "ecological" housing, which emerged in the 1970s. In recent decades, experiments and demonstrations have focused on technology development, increased productivity, and sustainable building.

Furthermore, housing research and development held an important part in building the Swedish welfare state since the early 20th century, thereby contributing to high-quality housing. Generous loans were granted for house construction, linked to definitions of "good housing" (e.g., Engfors et al., 2000; tinyurl.com/klmvzso). Based on meticulous empirical studies of people (mostly women) in action in laboratory environments, requirements regarding factors such as minimum spatial demand in relation to functionality, sunlight, or indoor climate, were developed in collaboration between academia and governmental bodies, and transferred to formal building regulations in the 1970s. In the 1990s, these somewhat restrictive regulations (not least for short-term cost efficiency) were replaced by general recommendations for functions in a dwelling. This shift coincided with a larger reorganization in which the government lifted their responsibility for funding housing and left further development to the market, the outcome of which remains a topic of debate (e.g., see Turner et al. [2002; tinyurl.com/lengj25] for an early evaluation).

Contemporary Housing Development

At present, there exist no Swedish governmental funds or grants of loans for real-world housing experiments, or building experiments in general. And, there were never any large programme funds available for experi-

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mental housing in Sweden, as was the case for example in France (Plan Urbanisme Construction Architecture, 2012; tinyurl.com/q8lk4rq) or in the Netherlands (SEV Housing Experiments Steering Group; tinyurl.com/o5uerma). Marginal qualitative experiments in housing continue to be developed by engaged and committed architects and clients. One example that is of interest for the Habitation Lab we plan is an experiment in affordable student housing called BoKompakt with a space of only 8.8 m^2 (less than 95 ft^2), which has received considerable attention (e.g., Fastighets Tidningen, 2012; tinyurl.com/kptltkk), although local planning authorities have contested further implementation. There is also new interest in co-housing as a means to address the increasing number of single households; Next Step Living in Gothenburg (nextstepliving.se/hem/) is one example.

Our recent observations of front-line sustainable housing developments indicate a strong market perspective, built on preconceptions among building professionals, which fails to deliver holistically adequate infrastructures to enable true sustainable living and dwelling (Hagbert et al., 2013; tinyurl.com/l5hgwct). There is a unilateral focus on efficiency and belief in technology as the ultimate solution to sustainable built environments, which overlooks possibilities for resident engagement. In addition, contemporary architects experience limited possibilities to engage in housing development on a more holistic level (Femenias et al., 2013; tinyurl.com/jw9rekb). The architects also seem to lack knowledge in issues regarding sustainability and do not benefit from a disciplinary debate in the field or significantly contribute to developing new practices for more radical explorations.

Innovation in Construction

The building sector has long been a focus for widespread critique regarding its perceived low level of innovation and failure to progress and change (e.g., Egan, 1998; tinyurl.com/62ad7a). It could, however, be argued that the building industry is not backwards per se, but different, and that comparisons with other industries are misplaced due to endogenous specificities of construction such as custom-order activity, complexity of production, high risk and costs, and a highly fragmented industry. (For an overview of these factors, see Nam and Tatum [1989; tinyurl.com/jvoyddv]). The interference of many factors of different character, such as site specificities, the assembly of multiple components and materials, production variation, and user behaviour, makes every building project rather unique and almost an experiment in its own right.

The use of single demonstrations or "best practice" as a method for change in construction has been criticized (e.g., Bresnen et al., 2005: tinyurl.com/keuhk6p; Fernie et al., 2006: tinyurl.com/nwjkahb). Although single experiments and demonstration projects have shown good results, they have had little influence on normal building practices, and experimental activities have been attributed a negative image in the industry (Femenías, 2004; demonstration-projects.com). Still, incremental changes in production and technology use have been the result of earlier experimentation, and the industrialization of production must be considered successful even though progress was slower than in other industrial sectors (Bougrain et al., 2010; tinyurl.com/kdgzh79). In recent years, Sweden has seen rapid development of low-energy construction that is driven by policies for energy use and cost savings but that is also mainly attributed to the systematic use of well-planned demonstration projects (Femenías and Kadefors, 2011; tinyurl.com/mfx9aqz).

There are several interlinked factors inhibiting change and learning relating to socially constructed features of the industry. As in many project-based industries, innovation in construction is mainly carried out in temporary projects and is often driven by individual champions (Nam and Tatum, 1989; tinyurl.com/jvoyddv). The practices and powers are widely distributed and localized, and the links between temporary project activities and more long-term and continuous management of the organizations involved tend to be weak (Bresnen et al., 2005; tinyurl.com/keuhk6p). In addition, a general lack of systematic monitoring and evaluation sets limits for continuous learning from project experiences (Femenías, 2004; demonstration-projects.com). Information dissemination and retrieval in the construction industry is strongly linked to individuals and their networks, using face-to-face communication (Styhre et al., 2006; tinyurl.com/kkl5jzt). This dependency on individuals and their networks further inhibits the broader implementation and diffusion of project-based experiences (Buijs and Silvester, 1996; tinyurl.com/ndyzump).

Femenias and Edén (2009; tinyurl.com/melvwrh) have defined a number of success factors for development projects in terms of hypotheses that are currently being researched. Some of the most critical factors include engaging top-level management and developing routines for evaluation, learning, and implementation of results.

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Organizations with better learning routines are more likely to both achieve and benefit from successful collaborations as they absorb and apply knowledge, including knowledge that is generated by others (Hartmann et al., 2010; tinyurl.com/kxtuyg4).

A Design Approach to Living Labs

With respect to the long knowledge-creation cycles in the building sector, the risk adversity to large-scale failure by industry, and limited governmental funding for housing innovation, among other factors, we see several motives for using experimentation in living labs to develop sustainable housing and challenge contemporary norms for living. We introduce the concept of a Habitation Lab, which was first defined by Professor Maria Nyström at Chalmers University of Technology as a living lab facility for the specific purpose of carrying out architectural and spatial experiments. A Habitation Lab could fulfil the need for arenas in which to conduct more radical experimentation and could lead to further innovation and development for sustainable housing. By actively involving the users, a Habitation Lab could potentially bridge the "rebound gap" between efficient technological structures and user behaviour to reach goals for sustainability; this value of living labs was also identified by Liedtke and colleagues (2011; tinyurl.com/9xv7gk6).

A Habitation Lab is defined as a high-fidelity lab permitting testing and development in real-time, focusing on the interface between "concepts of space use", residential functions and activities, and the users as residents and co-creators. A Habitation Lab will provide full-scale explorations, limited in space and time, which allow for high rates of experimentation and novelty. A Habitation Lab can be purposed built or installed in a real-world context, for example in existing housing.

In order to fully engage in and benefit from innovation in the living lab, the experimentation has to be well-planned, not least regarding monitoring and evaluation, and the engaged industry partners should establish learning routines to benefit from results. The lab setting has the advantage of providing a controlled environment to enable a more rigorous scientific investigation, yet simultaneously acknowledging the limitations to mimic real-world settings. In recent decades, virtual labs have been developed as a means to diminish risk in full-scale settings and enabling rapid digital prototyping. However, from a behavioural perspective, a limitation of virtual labs is that those results have been found difficult to replicate in real life.

To enable a networked innovation arena based on value creation for all involved parties (Ståhlbröst, 2012; tinyurl.com/l8ur4cu), we favour a neutral, transdisciplinary setting for a Habitation Lab. By applying the categories defined by Leminen, Westerlund, and Nyström (2012; timreview.ca/article/602), this setting can be seen as a hybrid between a provider-driven (i.e., academia-driven) living lab and a utilizer-driven (i.e., industry driven) living lab). Thus, users are important co-creators, but not drivers, and public-sector actors (e.g., planning authorities, non-governmental actors in the field of housing) are invited for observations and discussions. The transdisciplinary setting calls for openness and flexibility among participants; it adapts to the context of application and in turn allows for changes, enabling new participants to enter and new ideas to emerge over time (e.g., Gibbons et al., 1994; tinyurl.com/kqqdutk). We consider transdisciplinary approaches to be an ideal alternative to disciplinary research (which has more limited diffusion) for solving complex real-world problems in the field of sustainability.

What we aim for is a question-driven innovation arena where resource efficiency and human living functions are in the centre. The sharing of expertise and risk in collaboration between academia, industry, and users should increase the willingness to participate. The transdisciplinary configuration should contribute to increased openness, perceived ownership, reliability, and trust in outcomes and thus by extension, the implementation, uptake, and effect of results. The objective is to engage users, researchers, and industry partners in the co-creation of knowledge, strategies, products, and services. We aim for mutual understanding among all participants, based on personal insights and a discussion on changing home-based practices, which in turn are argued to have influence on professional practices.

By bringing together various disciplinary expertise, precedents such as the PlaceLab at the Massachusetts Institute of Technology (tinyurl.com/vggfq), have addressed the need to test new technologies and designs in environments providing “everyday” settings. Whereas the PlaceLab focuses primarily on observations of users and their interaction patterns with new home environments, the planned Habitation Lab focuses on the co-design of innovative solutions for space use with end users as well as their appropriation of these solutions. A more applicable reference is the 2005 Norwegian design experiment, TreStykke, which allowed users to create “a home” within a very limited space shared by other inhabitants (Thomsen and Tjora, 2006; tinyurl.com/l3oxerb). A Swedish experiment in the post-

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war suburban area of Tensta, where apartments were redesigned to raise the attractiveness of the area and the fit to the needs of contemporary users (Stenberg, 2012; tinyurl.com/ml323vz), shows the possibility of locating Habitation Lab ideas in a real-life context. Further inspiration can be drawn from Vision Live Elderly (tinyurl.com/mgs246m), a testbed and exhibition centre in Gothenburg, which provided development and innovation in housing facilities for the elderly.

Case Study: A Habitation Lab within the HSB Living Lab

The case study outlined here is based on work by a team of architectural researchers from the Department of Architecture at Chalmers University of Technology (chalmers.se) and the School of Design and Crafts (hdk.gu.se) in Gothenburg Sweden, and the College of Architecture at the University of Houston (arch.uh.edu) in the United States. The team also benefits from the participation of an architect from National Aeronautics and Space Administration (NASA; nasa.gov), and the extensive experience of researchers who have studied the effects of living under extreme resource limitations. The team is part of an inter-disciplinary research environment called Homes for Tomorrow (h42; homesfor tomorrow.se), which is located within Chalmers University of Technology. Homes for Tomorrow consists primarily of architects, engineers, and psychologists, and industrial design engineers further enrich this environment through collaborations.

A living lab facility, called the HSB Living Lab (hsb.se/goteborg/hsb-living-lab) is currently under development in relation to this inter-disciplinary research environment on one of the campuses of Chalmers University of Technology. The HSB Living Lab is linked to the SusLabNWE programme (Suslab; suslabnwe.eu), which supports the development of user-centred design research methodologies and sensor technology in several European countries. The lab is also supported by the Climate-KIC (www.climate-kic.org), Europe's largest public-private innovation partnership focused on climate change. The HSB Living Lab will be set up in collaboration with i) HSB, a cooperatively owned private housing developer, ii) Tengbom (tengbom.se), a nationally operating architectural consultant), and iii) representatives from different disciplines and organizations at Chalmers University of Technology and the Johannebergs Science Park (johannebergsciencepark.com), which bring together industry and science. The transdisciplinary setting is illustrated in Figure 1.

The plan for the HSB Living Lab facility is to provide both student accommodations and research facilities. We propose to install a Habitation Lab within this facil-

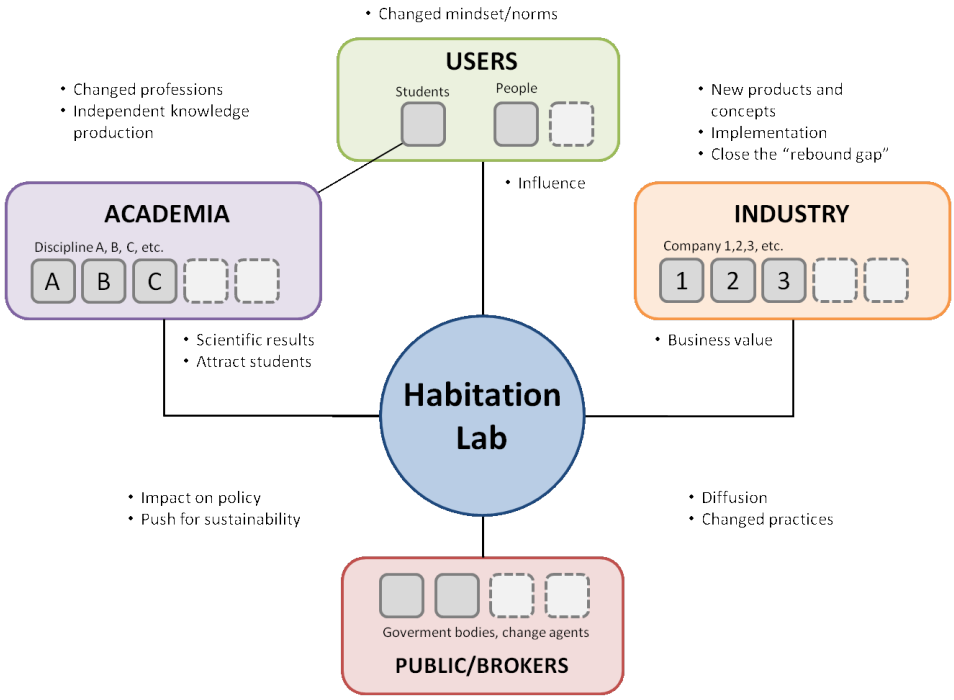

Figure 1. The transdisciplinary setting of the Habitation Lab, indicating possible generated value for different actors as well as diffusion and outcomes

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ity in the form of a design studio for research and educational purposes, in order to push for long-term change among future building professionals. Researchers and students in architecture as well as from other disciplines would participate in research and innovation in the Habitation Lab. The role of the researchers is to define the settings for experiments in which students will participate, and to observe, document, monitor, and evaluate results. For example, the design studio can take the form of a design–build–live experience, in which students accordingly have the role as designers and users, and if possible participate in the production of the "home" environment. The studio could feature game-like settings with resource-use targets that are defined by the researchers.

In planning the Habitation Lab, we have to prepare to meet several challenges. An iterative process must be developed, including continued reflection of the methodology based on recurrent evaluations and re-definitions. Other challenges with the Habitation Lab include the reproduction of real-life situations, ethical use of data, legal rights to results, and the challenge to sustain the lab over time, both financially and administratively. Furthermore, the effectiveness of isolated interventions that are not properly anchored should be avoided, further pointing towards the need for an integrative approach. More importantly, there is a paradox in the basic assumptions of a living lab: to create value for all involved. The sustainability agenda and the user-driven agenda might challenge the fundamental elements of the industry partners' business strategies, which might be, for example, to provide components and materials or entire dwellings on an economic market. The Habitation Lab calls for a flexible mindset in which participants can see beyond individual and organizational needs (Leminen and Westerlund, 2012; tinyurl.com/orlnfh5).

Defining Architectural Explorations

So what type of experimentation will be carried out in the Habitation Lab? As an example of an opportunity for exploration, a Norwegian study points towards "floor space per person" as one of the most significant indicators for energy use in housing (Hille et al., 2011; tinyurl.com/mzq5boq). Consequently, in order to radically challenge contemporary housing development and limit the environmental footprint of residences, research that defines and evaluates design explorations on spatial configurations regarding hierarchy and usage would be of prime interest. Experimentation could focus on optimizing living space and increasing the use of shared facilities at the same time as fulfilling different functional demands of living and dwelling (e.g., meal preparation, rest, work, social interactions).

In order to define research in relation to spatial design, we make use of several sources:

1. User-centred insights from studies conducted with participants from the target group of residents for the HSB Living Lab and student home (e.g., surveys and interviews with students)

2. Empirical studies of living functions (e.g., use of products, resources, and space) with targeted groups of people

3. Review of earlier research and experimentation of space use related to living and dwelling (e.g., living labs, full-scale building experiments)

4. Review of experiences from experimentation for space habitation (e.g., insights from NASA) and design for extremes on earth (e.g., to provide benchmarks for continued experimentation)

Interdisciplinary collaboration is also essential. We propose design as a method to systematically visualize and link different living functions in a dwelling. In addition, design allows us to connect different interdisciplinary research projects of a living lab, which have a direct link to these functions. In effect, this means formulating a type of systemic "tree" map, where living activities are related to each other, their respective resource use, and subsequently, appropriate research clusters. Furthermore, we will explore the contribution of architectural knowledge as a mediator in interdisciplinary and transdisciplinary settings of living labs, where different disciplines and professional actors meets; the form and outcomes of such links between actors are illustrated in Figure 1. Architectural knowledge includes the ability to understand the whole picture of usage in the meeting between object, function, and perception. In combination with the systemic ability of design thinking, architectural knowledge can be used as a means to structure and interpret results of more narrow, in-depth experimentation carried out by other scientific research groups.

The Habitation Lab: Using a Design Approach to Foster Innovation for Sustainable Living

Paula Femenías and Pernilla Hagbert

Conclusion

In this article, we have outlined a strategy for a Habitation Lab as an arena to foster research, experimentation, and innovation within the discipline of architecture. We envision the Habitation Lab as a vehicle for more radical innovation that questions fundamental issues relating to the use of space and resources for living. Such efforts are required to further develop contemporary housing in order to radically reduce the environmental footprint of our dwellings, thus pushing development of sustainable housing and norms for living beyond what is produced in contemporary front-line housing projects.

We have designed a case for a Habitation Lab within the planned HSB Living Lab on the campus of Chalmers University of Technology. The Habitation Lab, or parts of it, should be a design studio for educational purposes. We propose a transdisciplinary setting, where end users, building industry partners, and academia collaborate and are co-creators of ideas and innovative concepts. An important idea for the transdisciplinary innovation arena, as well as motive behind the involvement of education in the Habitation Lab, is to create a forum for social learning sustained by the sharing of insights on professional and personal levels among students, researchers, and participants from the industry.

Our design for a Habitation Lab has not yet been tested in practice. Continued research focuses on further specifications of partners and the transdisciplinary setting, the integration of the Habitation Lab in research and educational programmes, and the continued definition of specific parameters for architectural exploration. Once the first projects have been carried out in the Habitation Lab, the strengths and weakness of the lab setting must be evaluated to continuously enhance the outcomes. On a meta-level, it will also be important to study the influence of the Habitation Lab on innovation in mainstream building practices.

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About the Authors

Paula Femenías is an architect and Assistant Professor at the Department of Architecture at Chalmers University of Technology in Gothenburg, Sweden. Paula works in several ongoing interdisciplinary and transdisciplinary research projects focusing on innovation, development, and learning for more sustainable building. Her work includes developing the perspective of clients and owners and researching the specific challenges for redevelopment of the existing built environment from a multi-value and multi-interest perspective.

Pernilla Hagbert is an architect and doctoral student within the Homes for Tomorrow research environment at Chalmers University of Technology in Gothenburg, Sweden. With previous experience in planning and design, including design/build processes for constructing affordable housing, Pernilla's work addresses all scales of the development of more sustainable living environments. Her PhD research specifically examines the concept of home in light of and with regards to a global resource perspective, with the purpose of providing a framework for re-conceptualization of the sustainable home.

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Soile Juujärvi and Kaija Pesso

> *"It is essential to find the right people: those who are enthusiastic about the project."*
>
> An interviewee in this study

There is a growing trend to involve citizens in city development to make urban areas more suitable to their needs and prevent social problems. City centres and neighbourhoods have increasingly been serving as regional living labs, which are ideal platforms to explore the needs of users as residents and citizens. This article examines the characteristics and success factors of urban living labs based on a case study of Suurpelto, Finland. Urban living lab activity is characterized by a practice-based innovation process with diffuse and heterogeneous knowledge production that aims to address urban problems of varying complexity. User involvement is critical for co-creating value, but equally important is collaboration between other living lab actors: enablers, providers, and utilizers. Enabler-driven labs can be successful in creating common goals but they need providers, such as development organizations, to boost development. Proactive networking, experimentation as a bottom-up process, using student innovators as resources, as well as commitment and longevity in development work are success factors for urban living labs.

Introduction

City planners, universities, and technology companies are increasingly viewing urban areas as natural places to develop living labs. Urban areas, particularly that are newly built, offer opportunities to implement novel infrastructure, conduct longitudinal research studies, and co-create innovation with an engaged and readily identifiable set of users. In addition, urban areas with active living lab projects are often attractive to residents, because innovation activities create added value for them. Even though living labs have different focuses and their innovation activities represent diverse goals, urban living labs fit Westerlund and Leminen's (2011; timreview.ca/article/489) definition of the living lab as a virtual reality or a physical region in which different stakeholders form public-private-people partnerships of public agencies, firms, universities, and users collaborate to create, prototype, validate, and test new technologies, services, products, and systems in real-life contexts.

At least three types of urban living labs can be distinguished. First, urban areas can serve as technology-assisted research environments, in which users give feedback on products and services through webpages or sensor-based methods. In this context, the goal of a living lab is to improve an urban environment or local services, such as housing or public transformation. Second, users can co-create urban artifacts and local services, such as communal yards, garden allotments, or daycare services. Third, a living lab can develop new kinds of urban planning using new tools and processes with the engagement of citizens. In this case, the goal is to facilitate the vision-making of the area and planning procedures, and increase the access and mutual learning of stakeholders. Thus, a living lab can provide a platform for stakeholders to participate in a city's planning initiatives and decision making. In new urban areas, the boundaries between different living labs may become blurred because the many diverse actors may be simultaneously collaborating in multiple labs (Wallin,

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S., forthcoming: "APRILab: Guidelines to Define and Establish an Urban Living Lab", Urban Europe Joint Programming Initiative; jpi-urbaneurope.eu).

There is an accumulating body of research on living labs in general, but little is known about living labs whose primary denominator is a geographical area. Regional living lab activities have implicitly been studied as a part of regional innovation networks (Harmaakorpi and Niukkanen, 2007: tinyurl.com/njs3pfj; Melkas and Harmaakorpi, 2008: tinyurl.com/ke3r9n4; Kallio et al., 2010: tinyurl.com/m5lrnjf) and participatory urban planning (Wallin, 2013; tinyurl.com/pt9akzl). The urban living lab is an emerging concept referring to a living lab in a urban environment, such as a neighbourhood, that connects definite characteristics of both approaches.

This article examines the concept of the urban living lab and its success factors through an empirical case study. First, we discuss the concept of the urban living lab in the context of regional innovation networks and knowledge production. Then, we introduce the methodology and description of the case study. Finally, we present our findings and conclusions.

Urban Living Labs as Regional Innovation Networks

A regional innovation system is understood as a system of innovation networks located within a certain geographical area in which firms and other organizations are systematically engaged in interactive and collective learning through an institutional milieu characterized by social embeddedness. It typically consists of different kinds of multi-actor networks including actors with different aims and knowledge interests (see Melkas and Harmaakorpi, 2008; tinyurl.com/ke3r9n4). Regional innovation networks can be categorized as follows: i) large, loose regional networks, ii) heterogeneous multi-actor innovation networks, and iii) closed homogeneous public-actor networks (Harmaakorpi and Niukkanen, 2007; tinyurl.com/njs3pfj). Within this classification, living labs represent multi-actor innovation networks involving actors from different sectors of society with a commonly accepted goal; a commonly accepted coordinator steers activities and interactive learning is emphasized in getting results. (Harmaakorpi and Niukkanen, 2007: tinyurl.com/njs3pfj; cf. Leminen et al., 2012: timreview.ca/article/602). Regional innovation networks and living labs share the emphasis on open innovation and networking (Harmaakorpi and Niukkanen, 2007: tinyurl.com/njs3pfj; cf. Leminen and Westerlund, 2012: timreview.ca/article/602).

What are the crucial differences between these two approaches? First, regional innovation networks do not necessitate user involvement as living labs do. Second, they focus on the quality of knowledge creation and innovation process rather than actor roles and outcome accomplishment (see Melkas and Harmaakorpi, 2008; tinyurl.com/njs3pfj). An urban living lab can be seen as a special type of regional innovation network that puts emphasis on residents and their communities as users (i.e., ordinary people who want to solve their real-life problems). With regard to other actor roles, utilizers refer to enterprises and other service providers that want to develop their businesses in the area. Enablers include various public-sector actors and financiers, such as cities and area-development organizations that have far-reaching goals for regional and societal improvements, and that provide infrastructure and resources. Providers represent various development organizations, such as universities, educational institutes, and consultants offering tools and methods for research and development. All actors should acknowledge user participation and open innovation as key elements of the living lab (Chesbrough, 2003: tinyurl.com/nxupq2q; Leminen et al., 2012; timreview.ca/article/602).

Knowledge production in urban living labs

The most important lesson to be taken from regional innovation networks is their distinctive method of knowledge production, which emphasizes "learning by doing". The method is organized around a particular application and is heterogeneous, diffuse, and transient by nature. Innovators need to gather and combine different types of information from different types of sources at different times. This kind of knowledge production is called Mode 2, in contrast with Mode 1, which represents science-based innovation activity drawing on homogeneous accumulation of knowledge and clearly-defined problem solving within a particular discipline. (Gibbons et al., 1994: tinyurl.com/lmrh5eq; Melkas and Harmaakorpi, 2008: tinyurl.com/ke3r9n4). Mode 2 activity dominates knowledge production in regional innovation networks and, arguably, in urban living labs, where the innovation process is more practice-based than theory-driven. Scientific knowledge from various disciplines can offer tools for problem solving but cannot supersede place-based knowledge that is inevitably required to reach working solutions.

Wallin (2013; tinyurl.com/kgjbk77) further points out that problems in urban areas vary in complexity (see Baynes, 2009; tinyurl.com/ny5tsht) and therefore different kinds of problem solving techniques are needed in urban plan-

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ning. First, there are *simple complex problems*, such as bus routes or energy consumption, that can be demanding but still solvable through special expertise and Mode 1 thinking with a top-down process. Second, there are problems arising from *disorganized complexity*, such as the availability of services and workplaces, unemployment, or segregation, that are difficult to comprehend and handle due to their multidimensional and changing nature. These types of problems call for the emergence of Mode 2 thinking and a bottom-up process. Third, there are problems of *organized complexity* caused by a multiplicity of organizations that seem rational and well-steered but "end up in a [rigid], competitive, and overlapping system of administration that triggers wicked urban problems" (Wallin, 2013; tinyurl.com/pt9akzl). Problems of organized complexity can be especially compelling in urban living labs that involve public sector organizations, such as cities and municipalities, which are characterized by top-down planning and steering and which may contradict bottom-up innovation processes as well as parallel bureaucratic top-down processes.

Melkas and Harmaakorpi (2008; tinyurl.com/ke3r9n4) argue that proactive networking is closely linked to knowledge creation because innovation potential lies on boundaries between different groups and, consequently, actors able to span them are at higher "risk" of having good ideas. Actors also need to create shared long-term goals and prioritize them over short-term benefits; this process requires mutual trust and commitment (Kallio et al., 2010: tinyurl.com/n8gt3lx; Leminen and Westerlund, 2012: tinyurl.com/orlnfh5). An urban living lab should be flexible and adapt to rapid changes, but simultaneously be able to guarantee its stability in terms of crucial skills and accumulating knowledge (Leminen and Westerlund, 2012; tinyurl.com/orlnfh5). Coordinators of networks need strategic leadership and communication skills, as well as visionary thinking (Harmaakorpi and Niukkanen, 2007; tinyurl.com/njs3pfj). To summarize, previous research suggests that proactive networking, practice-based innovation, and commitment to long-term development, accompanied by strategic leadership, are success factors for urban living labs. In the next section, we present a case study of Suurpelto, a living lab in southern Finland, to better understand characteristics and success factors of urban living labs.

Case Study: The Suurpelto Urban Living Lab

Suurpelto is a new urban area located between major traffic routes in the city of Espoo in southern Finland. In Finnish, Suurpelto means "great fields": the area originally consisted of 325 hectares of uninhabited, park-like forest. Following development of the area, the first inhabitants moved in during the fall of 2010. The City of Espoo's planning process, which took place over a period of 10 years, was unique in terms of combining inputs from various stakeholders, such as building companies, land owners, and city representatives. According to the vision, Suurpelto would be an ecological city that is close to everything. Homes, workplaces, culture, and pastime services would all be within walking distance. The intention of the plan is to promote well-being for people at all stages of life as well as to encourage ecological sustainability and opportunities to smoothly connect work, family, and leisure activities. Suurpelto would also serve as a living lab for novel technology and new ways of living.

Suurpelto was designed to provide homes to over 15,000 people as well as thousands of jobs. Economical recession in the recent years has slowed down investment and the original vision has yet to be fully realized, but the new area has still attracted many development organizations, such as universities and, in particular, small-scale innovation enterprises. For instance, the authors participated in the two-year Koulii project, which was launched by Laurea University of Applied Sciences (laurea.fi) and the Espoo Vocational College Omnia in 2010 (omnia.fi). The aim of the project was to promote co-creation and experimentation of products and services suitable for the needs and life situations of users educators, students, and other stakeholders. During the project, the population of the area increased from zero to almost two thousand people, which offered valuable insights into the evolving living lab activity at a grass-roots level (Juujärvi and Pesso, 2012; tinyurl.com/k5wvm9d)

In terms of the type of living lab (cf. Leminen et al., 2012; timreview.ca/article/602), Suurpelto was an enabler-driven living lab from the beginning. The main enabler was the City of Espoo, whose decision makers and planners had created the vision for the new area in collaboration with land owners and construction companies. The City had made substantial investments for infrastructure before the construction process was initiated. The City of Espoo also started a region-specific project to support and manage the construction process and to enhance cooperation between various stakeholders and inhabitants. When the Koulii project, which was launched by the local educational institutions, joined the living lab, the lab's focus changed towards promoting research and creating knowledge based on place-based needs. The most visible change was student involvement and the implementation of a research

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strategy based on "realistic evaluation" (Juujärvi and Pesso, 2012; tinyurl.com/l59bz4w). As a consequence, activities driven by providers (i.e., the educational institutions) and activities driven by enablers (i.e., the City of Espoo) were merged and synthetized in collaboration.

Data collection and analysis

The data was collected from eight stakeholders participating in a panel discussion at a dissemination seminar, which was video recorded and later transcribed. Stakeholders represented two users (e.g., a chair of the neighborhood association), three enablers (e.g., a project manager from the City of Espoo) and three utilizers (e.g., a business developer of a shopping centre). The stakeholder data was complemented with relevant transcription data from seven group interviews of educators (providers) involved in the project.

The data was analyzed by inductive content analysis (Robson, 2000; tinyurl.com/mvedlr4), which yielded four themes: i) networking among living lab actors, ii) experimentation as a bottom-up process, iii) students as innovators, and iv) long-term development work. The following subsections describe the findings for each of the four themes and then discuss the contributions from different actor roles in an urban living lab. To make the results understandable in the context, the findings are complemented with the observations made during the research process.

Theme 1: Networking among living lab actors

The stakeholders emphasized that the creation of innovative services requires collaboration between all actors: users, utilizers, enablers, and providers. As the representative of a construction company put it: "We can bring walls and our expertise. But, to make things happen, we need enthusiastic service providers, developers, and interested people – especially those people in need of services. This [development work] will not continue unless they find each other and meet the needs of each other." The enablers pointed out that the educational organizations have a crucial role in enhancing networking. The Koulii project arranged several networking seminars and local events as well as provided various development methods that sped up community development.

The negative side of university-driven activity was the placement of too great an emphasis on the curricula and learning objectives, as well as students' and educators' limited commitment to development work due to their schedules. Ordinary development projects at educational institutions do not cover the whole innovation process but pieces of it, and consequently, the educators did consider the participation of all actors to be as critical as did the stakeholders. The educators mainly focused on the collaboration with users unless they realized that service production requires enterprises and providers as well. As one of the interviewees put it: "If only users and developers meet each other, nothing comes into existence."

All stakeholders and educators shared the viewpoint that creating networks with users and user segments is critical for successful living lab activity. However, it is important to not only connect with users but also to recognize and distinguish users' real needs from superficial ones. In the long-term collaboration, the inhabitants' real needs became evident. For example, a neighbourhood association in Suurpelto was set up for organizing urban gardening and leisure activities in collaboration with several actors, and it became one of the key partners in the area. There were resourceful new inhabitants in Suurpelto who had a wide array of expertise and who were eager to participate in the area development. From time to time, relationships between the educational institutions and inhabitants, however, became complicated due to the intensive collection of user-experience data in the small area. Some inhabitants felt that the data collection was of no value to them and only served the interests and objectives of the educational institutions. The educators concluded in the interviews that development work should be based on the real needs and strengths of inhabitants and that university-driven development activities should only add value to users through high-level expertise.

Theme 2: Experimenting as a bottom-up process

As implicated above, the needs analysis of residents was the primary research process in the living lab. It became evident that traditional methods such as surveys remained superficial and did not work in the small region. In order to gather valid user feedback, different unconventional methods were developed. Data collection took place through joint action at local events and workshops where participants were personally invited. Most importantly, students arranged different types of service experiments, such as health consultation hours and the cafeteria for parents of small children, in order to receive immediate user feedback. Even though the inhabitants' needs were charted in advance, it was almost impossible to forecast which service experiments would attract them. User feedback was used to shape

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service concepts. Difficulties, however, arose when the students tried to find business partners: most of them considered Suurpelto to be too small an area for investments.

Even though most service experiments followed public guidelines for social and healthcare policy, city officials were not interested in investing in area-based services. Nevertheless, some enterprises and non-governmental organizations were anticipating the future growth of the population and were thus interested in developing user-friendly products and services. Despite these difficulties, the stakeholders agreed that small-scale experiments that draw on the needs of users and inhabitants are the most effective way to advance innovative products and services as well as social innovations.

Theme 3: Students as innovators

Students played a crucial role in the living lab activities, mainly due to the pedagogical approach of Laurea University of Applied Sciences, which emphasizes "learning by developing" in different kinds of projects. From the students' viewpoint, living lab activities are interesting because they enable studies in a real-life environment. However, not all students were enthusiastic about real-life projects, and forcing their participation can cause more harm than benefit in the area. According to the educators, less motivated students should be placed "on the back stage" to carry out routine tasks. A more central role should be given to highly motivated students: they usually possess novel and even surprising knowledge that can be used in innovation processes.

The stakeholders pointed out that students are potential future entrepreneurs whose innovation ideas should be nurtured in the living lab environment. Living labs should provide possibilities for students to develop existing businesses and even start new enterprises. Living lab activities call for new competences that traditional educators may not possess. Educators as well as students must learn to tolerate uncertainty, search for knowledge from diverse sources and people, and think critically. Developing persistence is important, because development work can also be very frustrating when brilliant ideas are not always realized.

Theme 4: Long-term development

The ongoing construction process in Suurpelto will take decades to complete, which implies that there is a need to establish living lab activities over the long term. The enablers ensured that Suurpelto could be further developed as an innovation platform. As the first step, the City of Espoo was ready to employ a community coordinator to integrate development activities and to enhance networking among various actors. A community coordinator would host the local meeting place and information office, which had already been built and financed by Suurpelto Marketing. In addition, students would be recruited to do development work as interns on a regular basis. The enablers regarded the role of the educational institutions as crucial for pushing development. From the enablers' perspective, the Koulii project had brought a welcomed "buzz" to the area, enhanced community development, and contributed to place branding, which has made it easier and more attractive for others to become involved. Development should cover healthcare, wellbeing, and recreation services in order to make the area more convenient and attractive to people. Suurpelto would serve as a living lab for different kinds of pop up experiments, mobile services, and take-home services.

The educators also stressed the importance of establishing a permanent living lab platform, but for rather different reasons. The educators tended to see project-based development work as unethical from the viewpoint of users who have invested their resources in development work without benefitting from the outcomes due to the short timescales of the projects. A permanent living lab would enable long-term commitment from users as well as from educators and students. Participation in a long-term process would be more rewarding for users than short-lived experiences. The educators pointed out that a living lab that is established and resourced as a part of regular functions would enable the educational institutions to fulfill their legal responsibilities in regional development. The educators also emphasized the significance of systematic knowledge creation and knowledge accumulation through a research process that helps to make development work more effective and efficient in the long run.

Actor roles in an urban living lab

Box 1 summarizes the main contributions of each actor role. Enablers have an important role in creating an inspiring vision and inviting other stakeholders to participate in city development and place branding. Given that enterprises have difficulties seeing gains in regional living labs (Leminen et al., 2012; timreview.ca/article/602), enablers should put more effort into building partnerships with them at the early stage of urban planning. Complementarily, enterprises and other service

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Box 1. Contributions from different actor roles in an urban living lab

City representatives as enablers
- creating the vision and allocating resources
- providing strategic leadership
- promoting networking

Firms and local service providers as utilizers
- producing place-based knowledge
- setting small-scale objectives
- creating suitable products and services

Educational institutions as providers
- engaging students as innovators
- providing innovative R&D methods
- augmenting knowledge systematically

Residents as users
- producing place-based user experience
- participating in experiments
- empowering citizens through co-creation

providers should consider the long-term benefits of investing in innovative urban areas. Universities and other educational institutions can offer innovative methodologies and guarantee long-term development work through systematic knowledge augmentation. Students as innovators and teachers as service experts provide extra resources for innovation processes that should be utilized more.

Last but not least, we highlight the role of user engagement, which fuels the activities of living labs. The roles of users as residents and citizens in urban living labs are more comprehensive than in other types of living labs. Users can act as informants and testers as well as contributors and co-creators (Leminen, Westerlund, and Nyström, 2014: forthcoming in Volume 9 (Issue 1) of the *International Journal of Technology Marketing*; tinyurl.com/mdug2zv). Citizens have a natural motivation to participate in shaping their environments, and this motivation should be utilized through the development of new methods of co-creation and participation in community development (Horelli and Wallin, 2013; tinyurl.com/kgjbk77). The multiple roles residents play in regional and urban living labs have not yet been fully understood and need to be scrutinized in future studies.

Conclusion

The present study investigated the characteristics and success factors of an urban living lab. In line with previous studies (Kallio et al., 2010: tinyurl.com/n8gt3lx; Leminen et al., 2012: timreview.ca/article/602), proactive networking among living lab actors was a key success factor for our case, the Suurpelto living lab. Other success factors identified were experimenting as a bottom-up process, using student innovators as resources, and committing to long-term development work. Experimenting leans on practice-based innovation processes, which aim to address urban problems of varying complexity. Because urban living labs are often under city development processes over several years, they require long-term commitment to reach potential outcomes.

About the Authors

Soile Juujärvi is a Principal Lecturer at the Laurea University of Applied Sciences and Adjunct Professor at the University of Helsinki in Finland. Her research interests include moral and ethical development and innovation processes, especially networking, in living labs. From 2010 to 2012, she worked as a researcher in the Koulii (Innovation & Integration in Education) project, which was funded by the European Social Fund. She holds a Doctor of Social Science degree from the University of Helsinki.

Kaija Pesso is a Principal Lecturer at the Laurea University of Applied Sciences in Finland. Her research interests include ethics and health promotion and innovation processes in living labs. From 2010 to 2012, she worked as a researcher in the Koulii (Innovation & Integration in Education) project, which was funded by the European Social Fund. She holds a Doctor of Health Sciences degree from the University of Tampere, Finland.

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Open Innovation Processes in Living Lab Innovation Systems: Insights from the LeYLab

Dimitri Schuurman, Lieven De Marez, and Pieter Ballon

> *"Innovation happens because there are people out there doing and trying a lot of different things."*
>
> Edward Felton
> Professor of Computer Science and Public Affairs

Living labs have emerged on the crossroads of the open innovation and user innovation frameworks. As open innovation systems, living labs consist of various actors with each playing their specific role. Within this article, we will take an open innovation perspective by analyzing the knowledge spill-overs between living lab actors through three in-depth innovation case studies taking place within the LeYLab living lab in Kortrijk, Belgium. The results illustrate how living labs foster the three open innovation processes of exploration, exploitation, and retention. From our analysis, we conclude that living labs are particularly useful for exploration and, to a lesser extent, exploitation. In terms of retention, living labs seem to hold a large potential; however, the success and the nature of the innovation processes depend on the sustainability of living labs, the number of innovation cases, and the alignment of these cases with the living lab infrastructure. Based on these findings, a concrete set of guidelines is proposed for innovating in living labs and for setting up a living lab constellation.

Introduction

A shift in the dominant mode of innovation – from vertically integrated innovation towards a more distributed mode of innovation – has forced companies to alter both their research and development processes and their approach to innovation management. Instead of focusing on hiring people with all relevant skills and knowledge, and investing heavily in internal research and development capacities, companies had to actively look outside their walls for knowledge and technology to complement internal assets. This shift in the dominant mode of innovation not only required companies to adapt by developing or acquiring different skills and abilities, it also encouraged a growing body of research into the nature and occurrence of distributed innovation processes.

In the literature, there are two major research streams linked to the phenomenon of distributed innovation: open innovation and user innovation (Bogers and West, 2012; tinyurl.com/ba3gg3x). The *open innovation* paradigm takes the firm's perspective and examines the financial benefits of engaging in distributed innovation (West and Bogers, 2013; tinyurl.com/kcu2yw3). In contrast, the *user innovation* stream looks at distributed innovation processes from the perspective of the user (von Hippel, 2009; tinyurl.com/kj52zv5). In this stream, the focus of the analysis lies mainly on the utility gains the innovation brings to the user. A specific situation where these two perspectives come together is the case of user entrepreneurs, where users innovate and decide to commercialize their innovation themselves (Shah and Tripsas, 2007; tinyurl.com/mvo5sd9).

Within the context of distributed innovation, *co-creation* can be seen as a bridge between the perspectives of open innovation and user innovation. Co-creation moves beyond the single-inventor perspective to consider innovation as the collaborative development

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of two or more stakeholders. This process involves knowledge inflows and outflows between complementary partners, including horizontal and vertical alliances (Bogers et al., 2010; tinyurl.com/nxdeyb6). Beyond creating product innovation, co-creation can also be a way to create value more generally (Prahalad and Ramaswamy, 2004; tinyurl.com/m283r7v). Living labs – an innovation approach that has gained a lot of attention from European policy makers as well as innovation scholars since the mid 2000s – rely on co-creation as a central process for value creation (Levén and Holmström, 2008; tinyurl.com/pas5rmf). Therefore, as Figure 1 shows, we propose living labs as a potential bridge between open innovation and user innovation, two largely separate literature streams that are rooted in distributed innovation processes.

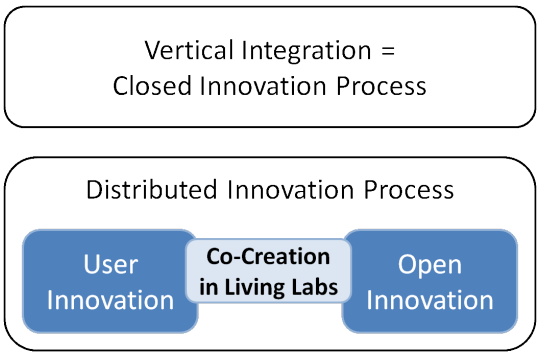

Figure 1. Positioning living labs amongst innovation paradigms

In this article, we focus on two specific types of living labs: i) living labs as extension to testbeds (tinyurl.com/yb75k6x) and ii) living labs that support context research and co-creation, as identified by Schuurman and colleagues (2013; tinyurl.com/ksl7ls7). These two types were selected because they are focused on innovation development relying on user involvement, whereas the "American-style" living labs and living labs focused on knowledge exchange are less about co-creation and more about exploration. This approach is in line with Almirall and Wareham (2011; tinyurl.com/lrz3dg2), who state that "Living labs are semi-partitioned spaces in the form of innovation arenas integrated in real-life environments but separated by means of an innovation project structure that cultivate user-led insights" and "living Labs are fundamentally infrastructures that surface tacit, experiential, and domain-based knowledge such that it can be further codified and communicated." This view suggests that the two types of living labs under our focus might be able to bridge the gap – identified by Bogers and West (2012; tinyurl.com/ba3gg3x) – between open and user innovation by facilitating the co-creation of innovation through connecting the innovative capacity of users (user innovation) with the innovative capacities of public and private stakeholders participating in living lab projects. We explore this hypothesis by means of a three innovation case studies, which take place in the LeYLab living lab (leylab.be) in Kortrijk, Belgium, and which examine the knowledge and technology flows between the involved stakeholders from an open innovation perspective.

Open Innovation Processes

Open innovation, conceptualized as a paradigm that assumes firms can and should use external as well as internal ideas and knowledge, was coined by Chesbrough (2003; tinyurl.com/d2l6bqx). He defined open innovation as a non-linear innovation process with more cooperation between internal R&D departments and the outside world, and with companies benefiting from the synergies associated with this collaboration. Factors that have favoured the shift towards an innovation model that is more open include an increased job mobility, the recognition of decentralized knowledge and shorter product lifecycles (van de Vrande et al., 2009; tinyurl.com/bqgk4t5).

From the perspective of a single firm – the usual level of analysis in open innovation research – the whole concept of open innovation is grounded on the premise that opening the internal innovation process of a firm yields extra value (Gassmann et al., 2010; tinyurl.com/mcx37tr). This opening results in inbound and outbound knowledge transfers: i) buying, which means internally acquiring external knowledge, ii) selling, which means externally exploiting internal knowledge assets, or iii) the simultaneous occurrence of both, a phenomenon referred to as the "coupled process" of open innovation (van de Vrande et al., 2009; tinyurl.com/bqgk4t5). Besides immaterial knowledge, materialized knowledge in the form of technologies can also be the subject of inbound or outbound movements, processes referred to as "technology acquisition" and "technology exploitation" by Lichtenthaler (2011; tinyurl.com/kbwtqom). He further highlights that knowledge and technology transfers are key processes being studied in open innovation literature. In Table 1, we summarize the three main goals for open innovation – exploitation, exploration, and retention – as identified by Lichtentahler and Lichtentahler (2009; tinyurl.com/llmdl3v), and we list the three corresponding firm capabilities required to pursue each of them.

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Initially, in open innovation research, these processes were studied within firms (inter-firm) or between firms (intra-firm), whereas later studies with a user innovation perspective examined how firms can collaborate with users to facilitate a process of external exploration beyond intra-firm processes (West and Lakhani, 2008; tinyurl.com/bas35oa). However, both processes have different hypothesized spill-overs: within open innovation research, these knowledge and technology spill-overs are situated amongst firms in an exchange or monetary modus (i.e., trading knowledge or technology for money or other knowledge or technology), whereas in user innovation research, these spill-overs from users to producers are not financial in nature (Bogers and West, 2012; tinyurl.com/ba3gg3x). There has been less research into retention processes, other than the literature on innovation intermediaries (Schuurman et al., 2012; tinyurl.com/okmz3cy).

This overview stresses the importance of external networking, including all activities to acquire and maintain connections with external sources of social capital, including individuals and organizations (Chesbrough, 2006; tinyurl.com/8x8byvv). Open innovation networks, which can range from informal links over collaborative projects to formal R&D alliances, allow firms to rapidly fill in specific knowledge needs without having to spend enormous amounts of time and money to develop that knowledge internally or acquire it through vertical integration (van de Vrande et al., 2009; tinyurl.com/bqgk4t5). Almirall and Wareham (2008; tinyurl.com/mkq7aql) identify a living lab as a specific type of open innovation network that acts as an innovation intermediary between users, public organizations, and private organizations to capture and codify user insights in real-life environments. By making this tacit user knowledge explicit and actionable for the different stakeholders, these innovation intermediaries seem perfectly fit to facilitate the identified open innovation processes. However, Almirall and Wareham (2011; tinyurl.com/lrz3dg2) only mention exploration and exploitation processes in their study of living labs from an open innovation perspective. We will complement their efforts by also looking at retention processes within our own case study analysis.

Table 1. Open innovation processes and corresponding firm capabilities

Goal	Definition	Corresponding Capability
Exploitation	Purposive outflows of knowledge or technology, implying that innovation activities to leverage existing technological capabilities lie outside the boundaries of the organization	Desorption
Exploration	Purposive inflows of knowledge or technology, aimed at capturing and benefiting from external sources of knowledge to enhance current technological developments	Absorption
Retention	The storage, maintenance, and reuse of knowledge over time	Connectivity

Defining Elements of Living Labs

In the literature, there is an abundance of definitions for living labs. For an overview of these definitions and of the most influential bottom-up and top-down conceptualizations, see Schuurman and colleagues (2012; tinyurl.com/mhjzhmh). Instead of building our own definition of living labs, we will start from a general model of living lab constellations, which is derived from Schuurman and colleagues (2013; tinyurl.com/lsxdkqo). In this view, the living lab infrastructure as a whole forms the centre of the living lab, with five general living lab characteristics depending on this infrastructure, as illustrated in Figure 2.

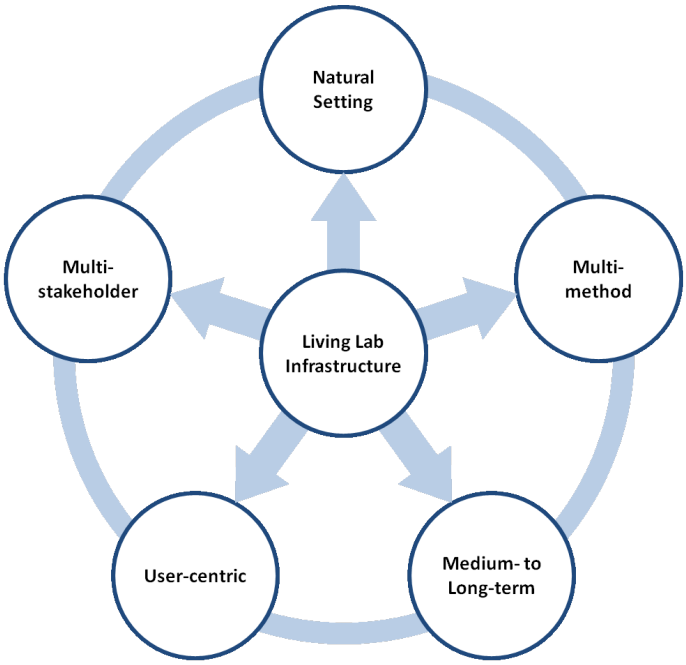

Figure 2. Defining elements of a living lab

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The *natural setting* in which at least part of the innovation process in living labs takes place is an obvious and widely discussed element of living labs. Pierson and Lievens (2005; tinyurl.com/9t9sylo) summarize the importance of this element by stressing that the uncontrollable dynamics of everyday life are accepted as part of the innovation environment which enables a "thick" understanding of innovation. The *multi-stakeholder* aspect of living labs is discussed by Leminen and Westerlund (2012; tinyurl.com/orlnfh5), who take an open innovation perspective on living labs and identify the four roles – user, utilizer, enabler, and provider – amongst the different stakeholders participating in living labs. These partnerships are more commonly referred to as public-private-people partnerships (4 Ps), or as quadruple helix models by Arnkil and colleagues (2010; tinyurl.com/koczuws) in their study on innovation networks.

Almirall and Wareham (2008; tinyurl.com/mkq7aql) further elaborate on the user as an equal collaborator in living labs, stressing a *user-centric innovation approach*: users are not considered passive respondents but active co-producers. Living labs also depend upon a *multi-methodological approach*, with different research methods aimed at accessing the ideas and knowledge of these users (Eriksson et al., 2005; tinyurl.com/8fv3jkp). This approach consists of *medium- to long-term research* (Følstad et al., 2009; tinyurl.com/okv7ott).

Last but not least, we see the *living lab infrastructur*e as an element that is essential in living labs, although this concept is used in multiple ways in the literature. In its most narrow sense, infrastructure refers to the information and communications technology that facilitates co-operation and co-creation among stakeholders (Bergvall-Kåreborn et al., 2009; tinyurl.com/lthwjpl). In its broadest sense, infrastructure refers to the distributed, networked living lab environment, the users and user communities involved in the living lab, the physical technical facilities (e.g., devices, networks, sensors), and the methods and tools used during living lab operations (Schaffers et al., 2009; tinyurl.com/kxhhnnx). We opt for a position in between these two extremes by making a distinction between the *material* and the *immaterial* infrastructure. The material infrastructure consists of the tangible assets that are brought into the living lab, such as physical networks, user devices, and research equipment. The immaterial infrastructure consists of the non-tangible assets of the living lab, such as end users, stakeholders, and the environment (see also Schuurman et al., 2013; tinyurl.com/lsxdkqo).

In theory, a living lab can be created and used only for one living lab innovation case, which is a specific type of living labs as defined by Ståhlbröst (2012; tinyurl.com/l8ur4cu). An example is provided by Schuurman and colleagues (2011; tinyurl.com/lj39xsk), where an entire living lab infrastructure was put in place for a mobile television trial and then it was disbanded after the project. However, most living labs are used for multiple innovation cases.

Three Case Studies of Innovation in the LeYLab

We examined three cases of innovation from the LeYLab living lab (leylab.be) in Kortrijk, Belgium. The LeYLab consists of a fibre-to-the-home network deployed to 115 addresses (98 households and 17 local companies and public organizations) within the city of Kortrijk. Users were connected and equipped with devices such as mini PCs connected to their main television screens and tablets (which were still a novelty in 2011). Optical fibre offered unprecedented test facilities in terms of bandwidth and quality of service. Therefore, the shared goal of the LeYLab was to stimulate innovation and to measure the relevance of new services for the personal lifestyle and living environment of the test users. Based on the goals and interests of the consortium partners, two main topics were chosen as focus for the living lab: innovative media and eHealth. All connected addresses received multiple surveys to profile the test-users for the relevant thematic domains, and all data and actions running on the LeYLab fibre network were monitored and logged. For a more in-depth description of the LeYLab living lab, we refer to our previous publication in this journal (Schuurman and De Marez, 2012; timreview.ca/article/606).

For our case study research, we looked into three concrete innovation cases that took place in the LeYLab: one internal case, consisting of the roll-out and usage of the fibre infrastructure, and two "external" living lab cases: Cloud Friends and Poppidups. One of the authors was directly involved in all cases as principal researcher, which enabled us to use the following data for our analysis: official meeting minutes of all project meetings, the project proposals, all deliverables and raw research data, and field notes of all formal and informal project meetings. The principal actors from our case studies together with their respective roles are summarized in Table 2. For a more in-depth exploration of stakeholder roles in living labs, we refer to Leminen and Westerlund (2012; tinyurl.com/orlnfh5).

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Table 2. Actors and roles in the LeYLab living lab

Actor	Role
City of Kortrijk kortrijk.be	Enabler of the roll-out of the infrastructure and link to citizens and local stakeholders
Alcatel-Lucent alcatel-lucent.be	Provider of the modems and monitoring of all network activity
Belgacom belgacom.be	Provider of the fibre network and the end-user devices (tablets and mini PCs)
Users leylab.be/innovators/test-panel	Testers of material infrastructure and innovative applications; participants in research (e.g., surveys, co-creation sessions)
iMinds iminds.be	Researcher and manager of test panels
Cloud Friends intenogroup.com/iopsys.aspx	External utilizer of living lab infrastructure with Cloud Friends application
Prophets prophets.be	External utilizer of living lab infrastructure with Poppidups application

Case 1: Fibre infrastructure

The first case involved the roll-out and usage of the fibre infrastructure itself (Table 3). The goals for both providers were twofold. First, by providing the fibre infrastructure and the devices to the panel members, the providers wanted to exploit these assets by allowing external parties to test applications and services on the infrastructure. This first goal, to attract a critical mass of external innovation cases to the infrastructure in order to generate a financial return for this exploitation of the network, was not very successful. After two years, only three external applications – including Cloud Friends and Poppidups – ran in the Living Lab, which cannot be considered a huge success. As of the beginning of 2013, the infrastructure was exploited through the participation in the European project Specifi (www.specifi.eu), where it serves as a testing area for the use cases that are given shape in the project.

As a second, long-term goal, both companies wished to exploit their infrastructure through a large commercial roll-out of fibre-to-the-home. This roll-out involved recruiting panel members, obtaining legal permits, and carrying out field work to effectively connect the test users. By surveying the end users before they were connected to the fibre network and at the end of the living lab, differences in attitude and usage could be assessed, as well as interest in the technologies. During the project, surveys were launched specifically aimed at panel members owning a tablet and at those owning a mini PC. In between these surveys, panel members were involved in various informal offline activities, and they could also provide spontaneous feedback by contacting the panel manager or by posting on dedicated online forums. All this research was facilitated and carried out by iMinds (iminds.be), an independent research institute founded by the Flemish government.

By having this data from a real-life panel of end users utilizing the fibre network, the devices, and the applications, both providers of the infrastructure could explore usage patterns and people's reactions to the offering, which were rather positive. This case also showed how this roll-out and exploitation could be organized and carried out in practice. Through the monitoring facilities of Alcatel-Lucent, all self-reported data could be contrasted with log files that contained all activity on the fibre connection at a household level, which allowed researchers to explore how these data sources might be combined. These efforts resulted in a segmentation of the households based on actual usage, and a model was developed to predict Internet usage, which was presented and published as a conference paper by Pianese and colleagues (2013; tinyurl.com/kjptyv7).

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Table 3. Open innovation processes in Case 1: the fibre roll-out

Exploitation	Exploration	Retention
• exploiting infrastructure as testing environment for innovators and in European project for use cases	• exploring future roll-out and exploitation of fibre-to-the-home • usage patterns and user reactions on devices and network • research possibilities with objective and self-reported data • policy exploration (smart city)	• model for predicting Internet usage • follow-up project application

This outcome is a tangible form of retention of the knowledge generated from the exploration of the datasets. Another example of a retention process took place at the end of the project, when five of the consortium partners started a joint effort to apply for a follow-up project attempting to retain the material as well as immaterial infrastructure. Last but not least, the City of Kortrijk, as a public stakeholder, was able to explore the effect of this kind of innovative information and communications technology project on the city ecosystem in the context of its goal of establishing Kortrijk as a "smart city" (tinyurl.com/pwmehou). In this way, the involvement of the City of Kortrijk and some of its citizens could be regarded as a form of policy exploration.

Case 2: Cloud Friends

Cloud Friends is a network-optimization application that also includes easy WiFi access management, developed by the start-up company Cloud Friends. From the start of the innovation project, it was clear that Cloud Friends was willing to exploit their technology, because they looked at the living lab project as an opportunity to get noticed by the providers of the infrastructure (Table 4). This case started with a co-creation session, facilitated and led by iMinds, with a group of tech-savvy panel members that were selected based on the results of the general surveys that were held amongst all LeYLab panel members. This outcome can be seen as a form of retention of the data obtained from the fibre roll-out case. During the session, the selected panel members discussed their current habits and practices regarding their home network configuration and the opportunities and threats of the Cloud Friends offering. The topic of easy WiFi access surfaced during this session, triggered by a discussion between a father and his son. This input was used in the further development of the application, as more emphasis was put on this specific feature.

After the co-creation session, the Cloud Friends application was installed on the modems of the fibre infrastructure in the households of the participants of the co-creation session. This outcome can be seen as an exploitation of the infrastructure by the providers, as mentioned in the previous case. Cloud Friends chose LeYLab as a living lab because, potentially, a lot of network conflicts could occur given that most connected households also had their own Internet connection besides the fibre infrastructure, which was an ideal test setting because the application deals with network problems. During the roll-out, it became apparent that the technical integration with the infrastructure was

Table 4. Open innovation processes in Case 2: Cloud Friends

Exploitation	Exploration	Retention
• intention to exploit technology to infrastructure providers • actual exploitation to external company based on user feedback	• insight into user needs and wants (e.g., WiFi guest access) • insight into technical performance in real-life setting • generated knowledge from technical integration with network	• data from general panel surveys used for user selection • extending duration of trial

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not as straightforward as expected, which required a lot of time and effort both from Cloud Friends and from the providers of the infrastructure. However, this problem provided an opportunity for exploration in terms of the technical feasibility of the solution. These efforts also had a direct impact on the eventual exploitation of the technology, because Cloud Friends were contacted during the project by Inteno (intenogroup.com), a large Swedish company that decided to buy the Cloud Friends solution in a licensing model, and later acquired the company in its entirety. The application kept the Cloud Friends logo, but its name was changed to Iopsys (intenogroup.com/iopsys.aspx). However, even after exploiting the technology, the actual field trial continued. By having a small but dedicated panel of test users, new features, issues, or ideas could be quickly validated, which can also be seen as a form of retention of the immaterial infrastructure (test users).

Case 3: Poppidups

Poppidups is a virtual puppetry application that is playable online with cards containing a unique quick-response (QR) code. The application was created by Prophets (prophets.be), a small online marketing agency based in Antwerp, Belgium. This innovation case started with an intake survey of over 200 respondents from the LeYLab panel, but also beyond the LeYLab test users, because Prophets wanted a broader validation of the Poppidups concept. After this quantitative assessment of user interest in Poppidups and its features, a co-creation session was held with a selection of respondents from the intake survey. This session was held in Kortrijk because a large proportion of the users willing to participate in this session were LeYLab panel members.

Before the field trial, a paid usability review was done by one of the original consortium partners of LeYLab, which can be seen as an instance of exploitation of its usability expertise, given that this partner was not involved in any other aspect of this case. After these preparatory research steps, a field trial was held with 40 testing households, which were selected from the intake survey and co-creation session. All testers received two feedback surveys during and after the field trial. The surveys revealed that user interest was low and that users especially were not willing to pay for the application; therefore, a separate field trial and co-creation session was conducted in a primary school situated in the LeYLab, because this setting was identified as a potential alternative market (Table 5).

The research carried out in this living lab case is a typical example of a company exploring the market potential, usability, and user reactions to a company's new offering. Because Prophets, an online marketing agency, lacked expertise and experience in the field of (digital) toys and consumer applications, they required an exploration of their envisioned market. A video with user reactions during the field trial was also made and put online as a tangible result of the research results. The test users could also keep the playing cards for the application, but the login accounts were suspended after a while and no additional feedback was requested from the test users. This winding-down of the field trial is related to a strategy shift regarding Poppidups. Prophets initially envisioned Poppidups as a business-to-consumer service, but based on the results of the field trial, the company decided to exploit the Poppidups service with a licensing model in a business-to-business setting.

Conclusion

In this article, we have considered living labs as innovation networks characterized by six defining elements: a natural setting, multiple stakeholders, multiple methods, a medium- to long-term view, user centricity, and some kind of living lab infrastructure. The potential of this living lab was put in practice by running innovation cases using this infrastructure. By means of an open innovation perspective, we analyzed the know-

Table 5. Open innovation processes in Case 3: Poppidups

Exploitation	Exploration	Retention
• paid usability expert review • Poppidups as license model to other companies	• exploration of market potential and user experience for new-to-the-company service • extra exploration by field trial in primary school	• some panel members from the LeYLab were active in co-creation and field trials • movie with user reactions as marketing tool

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ledge and technology transfers within three innovation cases in the LeYLab living lab. All three basic open innovation processes – exploitation, exploration and retention – occurred in the studied cases. Based on previous research (Almirall and Wareham, 2011; tinyurl.com/lrz3dg2), we expected that the exploration and exploitation processes would be balanced. However, they did not occur in equal amounts; the main processes from the case studies seem to be exploratory in nature. Stakeholders participating in a living lab want to access new knowledge in order to extend or optimize their technologies, services, or processes, or even policy in the case of the City of Kortrijk. Exploitation was less common and could be associated especially with consortium partners that act as providers of infrastructure and services, because the different cases allow them to exploit the assets they bring to the living lab. An unexpected result arose from the Cloud Friends case where an external utilizer of the living lab infrastructure started an innovation case for exploitation purposes. Smaller companies are confronted with the sharing paradox (Bogers, 2011; tinyurl.com/k6lwkyw), or the fact that in order to exploit their innovation, they have to (partly) reveal it to other companies who might "steal" the idea. However, Poppidups reached their goal without their ideas being stolen, but the actual exploiting of the innovation occurred outside of the living lab case. The Poppidups case also demonstrated a close interaction between the processes of exploration and exploitation, because the results of the exploration process led them to pursue an exploitation strategy rather than bringing their innovation to the market themselves. The retention process appeared to be the least frequent and could be mainly ascribed to the researchers who documented and disseminated their findings, including case-based findings as well as more general findings and adjustments to the methodological approach. These efforts can be reused in subsequent innovation cases running in the living lab, as was the case with Cloud Friends where, based on previous knowledge, an optimal selection of test users could be provided. There were also attempts to involve test users for a longer period of time for retention purposes, but the timeframe of our case study does not allow us to conclude anything regarding the success of this approach.

In general, these results suggest that running multiple innovation cases with a given set of test users and stakeholders with various external parties involved offers opportunities to accumulate knowledge and data over a longer period of time, which could benefit the stakeholders involved in the living lab as well as external parties. The model that was constructed out of the log files of the fibre infrastructure serves as a good example of this kind of knowledge retention and illustrates that not only the researchers should fuel the process of retention.

The sustainability of a given living lab is however a precondition to allow these retention processes. Because of the small amount of cases, this should be the subject of study in other living labs running over a longer period of time and having more cases to study.

An interesting solution in the case of the LeYLab was the exploitation of the living lab infrastructure in a large European project, which allowed the living lab to retain a minimal level of activity while trying to secure additional funding. Networking between living labs, as in this European project, is not only desirable for encouraging sustainability and fostering further retention processes, but would also facilitate the exploration and exploitation processes, such as assessments of technologies with larger user groups (as was the case with Poppidups) or external contacts in order to find a party for licensing or selling the innovation (as was the case with Cloud Friends). These living lab "suprastructures" might also be a fruitful avenue for further research.

From our study, a key takeaway can be abstracted for innovation managers and others involved in living labs: within living lab projects, it is possible to simultaneously improve a product or service and create a process of demand in envisioned use contexts and potential markets that confront real adoption barriers. This observation coincides with simultaneous processes of exploration and exploitation as suggested by Almirall and Wareham (2011; tinyurl.com/lrz3dg2), although it appears that living labs are particularly good for exploration purposes. However, living labs also hold a lot of potential in terms of retention of generated knowledge, especially when successive cases run on the same living lab infrastructures. Therefore, a clear thematic focus, a match between the innovations in development and the living lab infrastructure, and stakeholder goal alignment are factors that enhance the chance of knowledge being generated that can be re-used over time.

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About the Authors

Dimitri Schuurman is a Senior Researcher at the iMinds Media & ICT (MICT) research group and is responsible for the methodology of living lab projects facilitated by iMinds iLab.o. His involvement in living labs started in 2010 with the Mediatuin and LeYLab living labs. To date, he has managed over 30 concrete living lab projects that deal with new media and innovative use of ICT. He is currently finishing his PhD on living labs at Ghent University in Belgium.

Lieven De Marez is Research Director of the iMinds Media & ICT (MICT) research group and teaches on the topics of innovation research and new communication technologies in the Department of Communication Sciences at Ghent University in Belgium. MICT is one of 16 research groups within iMinds, and Lieven is also part of the management team of iLab.o, iMinds' facilitating infrastructure for living lab research.

Pieter Ballon is Director Living Labs at iMinds and Professor at the Vrije Universiteit Brussel in Belgium. He also heads iMinds' Market Innovation & Sector Transition research team, specializing in new business models for the telecommunications and media industries. He leads various national and international projects on open innovation platforms, real-life ICT experiments, and business models for media and ICT services. Since 2009, Pieter is the International Secretary of the European Network of Living Labs. From 2006 to 2007, he coordinated the joint research on business models for future mobile IP-based systems of the Wireless World Initiative (WWI) in the EU 6th Framework Programme.

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A Living Lab as a Service: Creating Value for Micro-enterprises through Collaboration and Innovation

Anna Ståhlbröst

> *"All entrepreneurs need to be competitive in order to push themselves to break new boundaries. But without collaboration, their ideas will never become reality."*
>
> Sir Richard Branson
> Business magnate and investor

The need to innovate is increasingly important for all types and sizes of organizations, but the opportunities for innovation differ substantially between them. For micro-, small,- and medium-sized enterprises, innovation activities are both crucial and demanding because of limited resources, competencies, or vision to innovate their offerings. To support these organizations, the concept of living labs as a service has started to emerge. This concept refers to living labs offering services such as designing the idea-generation processes, planning or carrying out real-world tests of innovations, and pre-market launch assessments. In this article, we will present the findings from a study of micro-enterprises operating in the information technology development sector, including the experienced value of services provided to the companies by a research-based living lab. We share experiences from Botnia, our own living lab in northern Sweden. In this living lab, our aim of creating value for customers is of key importance. Our study shows that using a living lab as a service can generate three different types of value: improved innovations, the role the living lab can play, and the support the living lab offers.

Introduction

Innovation is an important and oftentimes challenging task for many organizations, and for micro-, small-, and medium-sized enterprises, the task is even more challenging because they might not have the resources or competencies to innovate effectively. These organizations often are focused on their everyday operations and their core business, and they might not recognize opportunities to innovate even though innovation is required to sustain an organization. In addition, advocates of open innovation suggests that firms need to open up their borders and include external sources of knowledge into their innovation processes (e.g., Chesbrough, 2011: tinyurl.com/p78gtwf; Chesbrough and Appleyard, 2007: tinyurl.com/bp9gmee). This open approach has shown that large, technology-driven companies can benefit from relying extensively on external sources of knowledge in the innovation process (Chesbrough, 2003; tinyurl.com/kp33d22). Accordingly, intermediary organizations such as Innocentive (innocentive.com), NineSigma (ninesigma.com), and yet2 (yet2.com), have emerged to facilitate and support the innovation processes of all types of companies, including even brokers, third parties, collaboration services, and agencies (Howells, 2006: tinyurl.com/ljdg3sw; Katzy et al., 2013: tinyurl.com/mef7lun; Winch and Courtney, 2007: tinyurl.com/la4x7n3). In each of these intermediary organizations, the aim is to create value for clients by identifying, accessing, and transferring innovative solutions to problems in various stages of the innovation process. One type of innovation intermediary that is becoming increasingly popular around the world is the living lab (Almirall and Wareham, 2011: tinyurl.com/lrz3dg2; Cleland et al., 2012: tinyurl.com/mz3c86v).

A Living Lab as a Service: Creating Value through Collaboration and Innovation

Anna Ståhlbröst

Today there are approximately 330 living labs active in Canada, South Africa, Brazil, China, and many European countries, among others. These living labs often take the role of mediators between different innovation stakeholders such as users, large companies, suppliers, universities, small- and medium-sized enterprises, and governmental organizations (Almirall and Wareham, 2011: tinyurl.com/lrz3dg2; Ståhlbröst, 2012: tinyurl.com/l8ur4cu). Living labs also are proactive with respect to innovation and focus on supporting the development of innovations that help users carry out everyday activities, such as saving energy and communicating with their peers, in an improved manner.

For micro-enterprises (i.e., companies with fewer than 10 employees) in particular, a living lab can offer services such as supporting ideation, analysis, construction, deployment, use, evaluation, research, and management of innovation in real-world contexts. Currently, published research into the value of living lab services for micro-, small-, and medium-sized enterprises is rather limited, which hampers the possible impact these services can have in real-world innovation contexts. Previous research related to living labs and small firms has focused on the experiences of the living lab approach with special attention to the experiences of user involvement in the innovation processes of small firms (Niitamo et al., 2012; timreview.ca/article/608), or it has focused on the impact the living lab approach has on innovation processes carried out small firms (Ståhlbröst, 2012; tinyurl.com/l8ur4cu). To reap the benefits of living lab services, it is important to increase our understanding of how these services can offer value to stakeholders.

The purpose of this article is to examine the experienced value of a living lab's services for micro-enterprises. The micro-enterprises involved in the study all operated within the domain of information technology development. We interviewed the owners or managers of the company because they had experience of using living lab services and could therefore provide insights into the impact of such collaboration. In this article, a case study approach is adopted to explore a living lab that is situated at a university. This living lab focuses on: i) offering services that support the innovation processes of its different stakeholders, and ii) diffusing and contributing to research carried out in relation to the activities of the living lab; hence, it can be labelled a research living lab. Before moving to an analysis of the innovation process supported by the research living lab, we will discuss salient literature on living labs and experiences of value.

Customer Value

Among living lab researchers, it is common to view living labs as a specific research approach that supports user involvement and innovation processes carried out in real-world contexts (e.g., Bergvall-Kåreborn and Ståhlbröst, 2009: tinyurl.com/k6kya83; Leminen and Westerlund, 2012: tinyurl.com/orlnfh5). A quattro-helix approach is applied, which involves four different types of stakeholders in innovation processes: researchers, companies, users, and public organizations. Thus, a living lab is an environment that has a defined approach to support its actions. Typically, this approach is based on five key principles, which guide the operations of the living lab: value, sustainability, influence, realism, and openness (Ståhlbröst, 2012; tinyurl.com/l8ur4cu). In this article, we focus on the key principle of value; specifically, we examine the customer value that living lab services offer to micro-enterprises.

In its broadest sense, the value for a micro-enterprise can be expressed as the experienced difference between the benefits and sacrifices of their efforts in innovation processes supported by living lab services. For a micro-enterprise, this value can be a business value, in the sense that it contributes to long-term prosperity and growth. The term business value is somewhat intangible and includes all forms of value that determine the health and well-being of an organization in the long run. Hence, business value includes employee value, customer value, supplier value, managerial value, and societal value.

Case Description

In this article, the Botnia Living Lab (testplats.com) in northern Sweden constitutes the basis for our journey into the conceptualization of living lab services and their value. This living lab is part of an research, development, and innovation (R&D&I) joint venture with the Centre for Distance Spanning Technology (ltu.se/centres/cdt), whose main objective is to generate sustainable business innovation and innovation research. One of the roles of this living labs is to facilitate a real-life research context for strategies, tools, and services for open, user-driven service innovation, while at the same time supporting the innovation process for its stakeholders. Luleå University of Technology (ltu.se) is the host and legal body for the living lab's operations; a board of directors with industrial majority sets its strategic direction; and a core management team is responsible for tactical planning and daily operations. As an organization that is mainly driven by current pro-

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jects, the ongoing activities in the living lab are dependent on the collaboration between people from different organizations, which also can be related to the concept of provider-driven living lab (Leminen et al., 2012; timreview.ca/article/602).

This research-based living lab has a large network that provides expertise in many diverse areas, such as project management, information technology, entrepreneurship, business development, and policy making. Thus, to carry out innovation activities, the living lab does not need to have all the required competences residing within the organization; through its relationships with other organizations and individuals, it can access specific expertise for a particular project or task within a project. The operation of this living lab depends on different roles (Figure 1). For instance, there is a manager, who often functions as the contact point for customers or other stakeholders and with whom the cooperation is formalized with, for instance, signed business agreements and defined actions to be carried out. Other roles include the panel facilitator, who manages the end-user collaboration; the innovation process manager, who co-creates and implements the innovation process together with the stakeholders; and the researcher, who develops and implements new approaches and tools to test in the innovation process within the living lab and who analyzes the results of the process. Using this operational structure, the services the living lab offers were mainly related to applying for funding and managing the innovation process, including end-user engagement and the analysis and presentation of results from the innovation process.

Methodology

Given the inductive and exploratory nature of our research focus, we adopted a case study approach to illustrate the experienced values of using living lab services for micro-enterprises that want to innovate. A case study approach is appropriate for three reasons. First, case studies offer flexibility when it comes to the use of multiple data-collection methods to enrich the research findings (Yin, 2003; tinyurl.com/clf7wbd). Second, a case study generates rich stories rather than statistical information, and thus, it supports an enhanced understanding of the complexity of an organization from an insider perspective. Third, case studies make it possible for the researchers to gain a holistic view of the phenomenon under study (Walsham, 1995; tinyurl.com/nyca4vj).

Our goal was to obtain in-depth understanding of living lab engagements from the perspective of micro-enterprises. In total, five interviews were conducted at five different micro-enterprises that had been involved in the living lab's digital-innovation activities. We used a semi-structured interview format, which means that we used a pre-decided interview guide while we encouraged a discussion with respondents to drive the interviews questions. On average, the interviews lasted one hour.

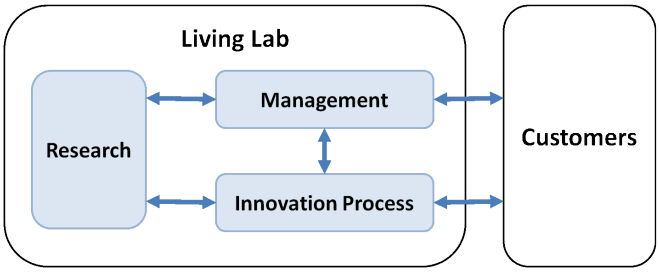

Figure 1. The organization of the Botnia Living Lab

The micro-enterprises involved in our study were from the same region as the living lab and had been involved in one or more short projects with the living lab during a period of five years. All of the businesses operated in the domain of Information technology system development in a business-to-business setting. The respondents were either chief executive officers (CEOs) or founders of the micro-enterprises, and they were willing to provide use with rich information about their experiences, through which we were able to acquire a "holistic view" of the companies' strategic and operational practices. All of the companies involved in the study were micro-enterprises (i.e., they had fewer than 10 employees).

In addition to the interviews, on-site observations at the living lab were combined with field notes from project meetings and informal observations of the innovation-project activities. In this study, the main objective of on-site observations was to understand how the interaction between the micro-enterprises and the living lab was organized and managed. The researcher has been deeply involved in the living lab's operations for a long time; some of these informal observations were made during daily activities such as planning meetings, lunches, and conferences.

The Value of the Living Lab as a Service

Prior to the coding of the collected data, the preparation stage consisted of activities such as transcribing interview tapes, typing research notes, and summarizing

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observation notes. The aim during the initial stage of analysis, the open coding, was to identify overarching themes and categories based on the collected data. This stage of the analysis was open and three themes did emerge: i) the role of the living lab, ii) the support it offers, and iii) the impacts of its services on the micro-enterprises. Based on these themes, the results were then analyzed to gain deep insights into the value received by the micro-enterprises, as discussed in the sub-sections that follow.

Role

When the micro-enterprises used the services offered by the living lab, it was often because of a collaboration initiative offered by the living lab. These initiatives were, for example, in the form of applying for a collaborative project together or as a result of the living lab contacting the micro-enterprises to offer their services to them. Based on their experiences from using the living lab's services, most of the companies appreciated the valuable perspective that the living lab was able to offer them in terms of critical insights into their innovation process. For example, the living lab was perceived as having its has an eye of the future on the innovation instead of only focusing on the business aspects of the interaction. This view is based on the living lab's goal of helping the micro-enterprises further develop their innovations into mature solutions, even at an early and premature stage. They focus on the specific innovation and its results, as one of the interview subjects stated it, "The living lab focuses on something more concrete, as specific projects focus on developing products and services". The living lab does not have any financial interest in the innovations because they have not funded their development, and this was viewed by the micro-enterprises as a further value in their collaboration. Accordingly, the micro-enterprises found that the living lab can be more objective and take on a critical perspective on the innovation. For the micro-enterprises, objective, critical feedback is valuable because they want to develop the best innovations possible, and they often have invested a lot of resources into the innovation. Hence, the living lab focuses on a micro-enterprise's innovation and development process, not on their business.

Support

In this study, micro-enterprises were also found to value the support provided by the living lab in managing the innovation process. Many micro-enterprises do not have the competence or resources to drive that process themselves, hence they appreciate that living lab is an innovation-process leader that focuses on involving users and researchers. The living lab has a well-defined innovation process in which they involve different stakeholders, such as users, industry, and researchers as required, and the micro-enterprises saw that as a benefit. As one of the interview subjects expressed it, "The living lab should have a supportive role, like an advisory board". Furthermore, one of the main benefits indentified by the micro-enterprises is the involvement of researchers in the process. In this way, the living lab can strengthen the innovation power of the micro-enterprises by involving the right competence at the right time. The micro-enterprises also stated that they see the living lab services as a networking service where they receive support in establishing new business relations and setting up meetings with industry and researchers from the living lab's large network of partners and relations. Thus, the living lab can function as a network hub where they intermediate the intersection between different stakeholders to ensure that the right competences meet and thus boost the innovation effort. In this way, it becomes possible for the micro-enterprises to start new collaborations, and that strengthens their commercialization process. The living lab becomes a fertile ground for establishing new business relations.

For many micro-enterprises, it can be hard to find and engage resources that do not reside within their own company due to their vulnerability and focus on their everyday business. But, the living lab can not only support the micro-enterprises in finding the right collaboration partners or driving the innovation process, the micro-enterprises also value the lab's suggestions for tools that they can use to support their innovation process and the help the lab provides in the process of selecting and involving users in their development processes.

Even though the living lab can contribute with support in different ways, they face a challenge in deciding how much support they should offer. Here, the micro-enterprises expressed an expectation and need for a lot of support which, if they would pay for the service, would have been rather expensive. Hence, one challenge for the living lab when they offer services is to find the balance between the costs and benefits of support. This challenge is also related to the micro-enterprises' need to receive fast and agile support in the form of input into the innovation process. Working with micro-enterprises also includes the challenges of stable financing. Here, one expectation from the micro-enterprises was

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that the living lab should also be able to finance smaller development projects. The living lab often applies for funding of innovation activities in collaboration with the micro-enterprises, and this is often a long process, especially for micro-enterprises that need to quickly respond to changes in their business context, which is difficult to accomplish in large and long projects. In summary, expectations of micro-enterprises must be managed with regards to the services offered by living labs.

Impacts

The micro-enterprises also responded that their products and services became better due to their collaboration with the living lab. Based on feedback from users during such collaboration, they found that they could, for instance, make their products easier to use. The micro-enterprises also learned a lot about innovation and how users can be involved in their process. Despite its importance, gathering feedback from users is often missing from the innovation process of micro-enterprises because they lack either the knowledge or the resources to carry out these activities. With help from the living lab, these micro-enterprises were able to involve users in their processes, thereby not only increasing their knowledge and understanding of their products, but also of the value of involving users in the innovation process. As a result, the micro-enterprises began involving users in innovation processes that were unrelated to their involvement with the living lab.

The micro-enterprises also found that using living lab services shortened their development time as well as their innovation process, because they could test and validate their innovation quickly. Typically, micro-enterprises need to invest large amounts of time to secure commercial success of their developments, but because living labs provide access to end users, they can provide timely feedback in both early and late stages of development. Furthermore, the micro-enterprises received increased visibility in the media and in the community, because the living lab released press releases, organized events in the city, and published information about their activities and events online.

Conclusion

With this case study, our aim was to explore the value of the services offered by a research-based living lab, as experienced its micro-enterprise customers. Based on the results from this research, we conclude that living lab services provide value to micro-enterprises in three different ways: i) the micro-enterprises appreciate the role the living lab takes in the innovation process, ii) they benefit from the support the living lab offers, and iii) the living lab's services directly impact the quality of the micro-enterprises' products or services and their innovation processes.

Micro-enterprises frequently work in isolation; hence, they value opportunities for insights from an outside perspective. In this study, we found that the living lab services offer opportunities to gain multi-dimensional input on an innovation. This value is created through the engagement of users and other relevant stakeholders in the process, but also by the different roles play by the operational personnel in the Living Lab. This study has shown that a living lab can play the role of collaborative partner, constructive critic, innovation-process manager, and innovation adviser. Thus, micro-enterprises can receive valuable insights from an external partner that is focused on the innovation process, and this process in turn makes it possible for these micro-enterprises to boost their innovation capacity.

In this study, we also found that many micro-enterprises do not have the capacity to innovate by themselves, especially when it comes to including other stakeholders such as end users in their innovation process. Either they do not have access to users, or they do not know how to involve users in an efficient manner. We found that micro-enterprises value the support that living lab services provide to their innovation processes. Our findings show that supporting involvement of various stakeholders such as end users in the innovation process, the strengthening of the innovation power through the engagement of various competencies, and the support in networking provide micro-enterprises with fertile ground for innovation.

When it comes to the actual impact of living lab services, this study shows that these services can lead to an increased visibility, a shortened development process, improved products, and an enhanced learning and understanding about innovation processes and user involvement. The living lab can support the micro-enterprise by bringing their innovation to other stakeholders such as users and media. This process, in turn, offers opportunities for the micro-enterprises to expand their businesses and also to understand their markets more thoroughly. This finding is of special interest to newly started micro-enterprises and those trying to reach a new market with their innovation.

To further deepen the knowledge about this phenomenon, a broader study of micro-enterprises and their ex-

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periences of using a living lab as a service is needed. Future research should seek in-depth understanding of the nature of the services that are offered by the Living Lab and the stakeholders using these services. In addition, researching the experienced values from living lab services offered by different types of living labs, as suggested by Leminen and colleagues (2012; timreview.ca/article/602), would be fruitful.

About the Author

Anna Ståhlbröst is a Senior Lecturer in Social Informatics at Luleå University of Technology, Sweden, where she also holds a PhD in Social Informatics. Her research is focused on the phenomena of living labs and open, user-driven innovation processes, with special interest in service innovation and end-user needs and motivations. Anna's research is related to different application areas such as energy, domestic-IT use, and smart cities. She has participated in several international and national innovation and research projects, and she has contributed to the field with more than forty journal and conference articles.

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