Key Constructs and a Definition of Living Labs as Innovation Platforms

Mika Westerlund, Seppo Leminen, and Christ Habib

> *"If you want people to listen, you have to have a platform to speak from, and that is excellence in what you do."*
>
> William Pollard (1828–1893)
> Clergyman

Despite the growing popularity of using living labs as innovation platforms and the increasing scholarly attention toward the topic, still relatively little is known about many of their central characteristics. We use a qualitative research approach to identify key constructs of living labs and to understand how these constructs show up in the operation of living labs. So doing, we used theoretical constructs from the literature on user innovation, co-creation, and living labs to analyze a sample of membership applications to the European Network of Living Labs (ENoLL). The results from the content analysis of 40 applications revealed nine key constructs that are characteristic to living labs: 1) objective, 2) governance, 3) openness, 4) stakeholders, 5) funding, 6) value, 7) communications, 8) infrastructure, and 9) methods. These key constructs provide new insight that helps us to provide a definition of living labs as innovation platforms.

Introduction

In today's rapidly changing world, innovation success requires group creativity that is facilitated through interactive processes (cf. Holst, 2007; Leminen et al., 2016). The use of living labs has become increasingly popular because they offer a multiple-stakeholder platform for collaborative innovation in real-life contexts (Leminen, Rajahonka, & Westerlund, 2017a). Although the roots of modern living labs are often associated with Massachusetts Institute of Technology (MIT) professor William Mitchell's real home environment for investigating the application of smart home systems in the day-to-day activities of humans (cf., Eriksson et al., 2005; Budweg et al., 2011), numerous studies refer to living labs prior the MIT's activities (cf. Følstad, 2008b; Leminen & Westerlund, 2016). However, scholars in the early days of living labs considered living labs somewhat differently from today. Leminen, Westerlund, and Nyström (2012) defined living labs as "physical regions or virtual realities in which stakeholders form public–private–people partnerships (4Ps) of firms, public agencies, universities, institutes, and users all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts."

Since its conception, the living labs approach has evolved into many fields of research and applications. A recent study by Westerlund and colleagues (2018) found that research approaches to living labs can be categorized under seven broad topics: 1) Design, 2) Ecosystem, 3) City, 4) University, 5) Innovation, 6) User, and 7) Living lab. The seventh topic examines what living labs and their defining characteristics are, and its subtopics are focused on providing taxonomies, typologies, and categorizations. However, there is still not one commonly accepted definition of "living lab", and many fundamental aspects of living labs remain dispersed (Westerlund et al., 2018). In particular, scholars in the field disagree on the components that make living labs both unique and similar to other innovation platforms (Anttiroiko, 2016; Dell'Era & Landoni, 2014; Leminen, Rajahonka, & Westerlund, 2017; Ojasalo & Tähtinen, 2016). Leminen (2013) argues that the lack of a proper definition is the cause of disconnected research. Hence, there is a need for research on how living labs view the essentials of their operations.

This study aims to identify the key constructs of living labs by using a qualitative research approach. We review previous literature on living labs and compare it with literature on user innovation and co-creation for

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the purpose of identifying central constructs by which living labs can be examined in terms of their defining characteristics. We use these constructs to analyze 40 membership applications received by the European Network of Living Labs (ENoLL; https://enoll.org) in order to reveal how the constructs show up in the operation of living labs, and we provide a research-based definition of living lab platforms. The derived constructs and the definition help us understand living labs as collaborative innovation platforms. The study concludes with implications derived from our analysis.

Literature Review

User innovation

More and more companies are shifting the task of revealing and understanding user needs to users themselves. One of the drivers is the understanding that user innovation happens anyway and is a mass phenomenon that companies should not overlook (Franke et al., 2016). By providing users with innovation toolkits and various resources, companies can outsource the innovation activity to customers and other stakeholders, and bundle these actors into the company's own product development process (von Hippel & Katz, 2002; Bogers & West, 2012). Toolkits can be introduced into user communities, meaning groups of users who share and disseminate information about a particular good (Parmentier & Gandia, 2013), and therefore put the users to work to harness new and reliable innovation (Sawhney & Prandelli, 2000).

To encourage participation and contribution, companies must support users' intrinsic and extrinsic motivations. The former is the internal gratification a member receives from working towards or achieving a goal within the community, and the latter refers to the external forces that encourage participation regardless of intrinsic presence. Extrinsic motivation includes, for example, recognition by the firm (Jeppesen & Frederiksen, 2006), peer reputation (Hertel et al., 2003), monetary incentives (Jeppesen & Lakhani, 2010), and reciprocity of solutions. In addition to motivational factors, proper leadership can steer the evolution of projects and choose the best fitting solutions. Despite hierarchical coordination possibly dispiriting intellectual creativity, such governance structure needs to be in place to allocate roles and tasks to the members (Bonaccorsi & Rossi, 2003).

A major problem companies are facing when utilizing user innovation is how to create a business model to profit from it (Franke & Shah, 2003). To this end, proprietary business models can attempt to solicit license agreements from the innovators (West & Gallagher, 2006). Indeed, management of intellectual property (IP) is central to controlling knowledge and determining ownership of the innovation (Bogers & West, 2012), especially given that strong IP regimes by the firm can retard the innovation spirit of the user community (von Hippel & Katz, 2002).

Co-creation

Co-creation is a collaborative innovation activity that enhances both customer and company value (Schnurr, 2017). It extends the user innovation process by appropriating ideas from customers and stakeholders to enhance the product and create new experiences (von Hippel & Oliveira, 2011). Co-creation engages participants in collaboration to develop a "we" competency rather than a differentiated "you" and "I" interaction (DeFillippi & Roser, 2014; Lee et al., 2012). This means working together and consolidating resources over a network (Gassmann et al., 2010). Customers participating in co-creation may not receive direct social or economic value (Chen et al., 2012). Rather, intrinsic factors such as enjoyment (Fuller et al., 2007), a sense of belonging (Zhang, 2010), or potential career advancement (Wasko & Faraj, 2005) contribute to their participation in co-creation.

Co-creation consists of five areas: co-ideation, co-evaluation, co-design, co-test, and co-launch (Russo-Spena & Mele, 2012). Co-ideation means that members propose innovative ideas to the community, which are then discussed and refined. Co-evaluation focuses on the appraisal of the ideas; high-ranking ideas are reviewed by top management for business potential and passed onto others to determine the costs and benefits of implementation. Co-design is the implementation of approved ideas and requires resources such as toolkits and knowledge. Co-testing helps refine the new product and gain feedback before launching to market; the pre-commercialized product is tested, refined, and presented iteratively until it reaches satisfactory levels. Finally, co-launch means that the product is released to market and will have early adopters who promote it via word-of-mouth.

Lee and colleagues (2012) argue that co-creation improves the architecture of products (resulting in better quality) and lowers the costs of production. Due to the parallel nature of collaborative development (cf. Russo-Spena & Mele, 2012), the product lifecycle is shortened, allowing for faster launch and increased speed to market (DeFillippi & Roser, 2014). In addition, the diversified

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collaborative network enables organizations to become more efficient and agile for rapid scaling (Adler et al., 2011). Furthermore, co-created innovations have a lower risk of market failure because they are associated with higher customer satisfaction, positive word-of-mouth, and a lower likelihood of customers seeking out competitive solutions (DeFillippi & Roser, 2014).

Living labs

The living lab is an innovation approach that benefits the creation of products and services (Liedtke et al., 2012; Veeckman et al., 2013). Building on co-creation, living labs provide physical and organizational infrastructures (Ponce de Leon et al., 2006), as well as a methodology and tools to coordinate the experimentation process within a variety of real-life environments (Almirall & Wareham, 2011; Leminen & Westerlund, 2017). Living labs are based on user-driven approach and the open involvement of many stakeholders (Nyström et al., 2014), and they engage diverse members to collaboratively undertake projects and develop and validate innovations (De Ryuter et al., 2007; Leminen, Rajahonka, & Westerlund, 2017; Schuurman et al., 2011; Westerlund & Leminen, 2011). Trust between stakeholders is necessary to facilitate the equal and fair exchange of knowledge, resources, and efforts in innovation activities (Leminen & Westerlund, 2012).

Living labs give insight into hidden and identified user and consumer needs in real-life contexts (Leminen, Westerlund, Nyström, 2014; Leminen, Nyström, & Westerlund, 2015). Research on living labs analyzes and documents a broad variety of innovation and development activities with diverse stakeholders, and it investigates how living labs apply tools in different ways (Leminen & Westerlund, 2017). Information about users may be collected in general networks (Leminen et al., 2016), digital networks (Intille, 2002), or cross-border networks (Schaffers & Turkama, 2012), and analyzed to identify user patterns and opportunities (Edwards-Schachter et al., 2013; Nyström et al., 2014). Citizens are encouraged to socialize, suggest ideas, and engage in innovation development (cf., Mulder, 2012). The approach mitigates the risks associated with market commercialization (Liedtke et al., 2012) and results in sustainable value in smart and urban city contexts (Leminen, Rajahonka, & Westerlund, 2017a; Rodrigues & Franco, 2018; Tukiainen et al., 2015).

Users that participate in living labs represent various consumer groups, lead-user communities, research organizations, or employees of firms (Niitamo et al., 2012). They may be seen both as passive and active respondents (Schuurman & De Marez, 2012) and an object for testing and feedback (Følstad, 2008a; Schaffers et al., 2007) but also subject for co-creation and co-development activities (Leminen, Nyström, & Westerlund, 2015). Thus, users may take or make roles in living labs (Nyström et al., 2014). A living lab provides resources to convert ideas of stakeholders into products and services (Leminen et al., 2012; Nyström et al., 2014). The industry partners, in turn, take on the role of developers and join living labs to access external ideas provided by the others (Leminen et al., 2012). They benefit the living lab's resources, networks, and techniques by finding opportunities and developing solutions that meet the needs of users (Leminen & Westerlund, 2012; Levén & Holmström, 2008). Finally, researchers are stakeholders who focus on the generation of knowledge (Dell'Era & Landoni, 2014), and they often support innovation and development activities (Logghe & Schuurman, 2017).

Living labs offer various benefits to participants, including networking opportunities and access to funding and resources (Leminen, Rajahonka, & Westerlund, 2017; Niitamo et al., 2012). Research conducted with living labs often yields unique knowledge that is otherwise difficult to achieve (Dutilleul et al., 2010). The living lab carries out research, development, and experimentation with products and services (Leminen, Westerlund, & Rajahonka, 2017). Thus, the living lab attempts to analyze users and co-create outcomes for the benefit of diverse stakeholders and society (Kanstrup et al., 2010; Leminen & Westerlund, 2018). Such knowledge can validate the innovation and ensure initial demand for the product prior to commercialization (Almirall & Wareham, 2011). Last, the tangible outcomes (product, services, and systems) and the intangible outcomes, activities, and values (e.g., employee support, supplier value, managerial tasks, and societal value) that help businesses to develop and support the well-being of users are part of the living lab mandate (cf. Kåreborn et al., 2010; Leminen, 2015).

Common constructs

A comparison of the three reviewed innovation concepts and their underlying literature reveals that they share at least six defining constructs:

1. Stakeholders: Parties who are involved in the innovation process.

2. Objectives: The advantageous benefits of the output from the innovation process.

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3. Governance: The manner in which the decisions in the innovation process are made.

4. Tools: The resources required to carry out innovation activities.

5. Motivation: The reasons why stakeholders participate and the techniques used to promote participation.

6. Business appropriation: The direct or indirect means to capture monetary value from the innovation outputs.

Methods

In order to understand key constructs of living labs and how they show up in the operation of living labs, we draw on the case study approach. According to Baxter and Jack (2008), case study research can facilitate the exploration of living labs, allowing for multiple facets to be revealed, especially when little is known of the phenomenon or its boundaries are unclear. The case study approach can yield theory that is unified and grounded in practice (Eisenhardt, 1989). Thus, we use case studies and content analysis of the text generated from the cases. Content analysis is a systematic technique used to evaluate qualitative content by converting textual data into a numerical form that can be subjected to quantitative analysis (Wolfe et al., 1993).

This research was limited to the qualitative data extracted from 2011/2012 ENoLL membership applications, which consisted of: 1 Australian, 4 Belgium, 2 Colombian, 1 German, 1 Danish, 10 Spanish, 5 French, 2 Greek, 1 Irish, 4 Italian, 2 Mexican, 1 Polish, 1 Saudi, 1 Slovenian, 2 Turkish, and 2 British datasets. Each living lab seeking to become a member of ENoLL is required to complete and submit an application form that is standardized with key questions and profile description including, for example, basic information, membership motivation, objective, key resources, degree of openness (intellectual property rights), user involvement policy, value to stakeholders, future plans, metrics, etc. We narrowed the dataset from 332 cases down to 40 by focusing on living labs that had both an application and a profile completed. First, we prepared detailed write-ups of cases (within-case analysis) to summarize relevant information. Then, we used content analysis on the write-ups to find themes. For content analysis, we conducted manual pre-editing of the data to simplify sentence structures into singular context phrases and convert words into clearly defined nouns.

We developed the coding rules used to observe the units within the text by constructing an Excel macro formula: [=OR(IF(ISNUMBER(SEARCH("KEYWORD", A2)),1,0))]. This macro was used to group phrases based on the specified keyword. A group termed OTHER was added to each search to highlight phrases that were not categorized and to highlight phrases that were categorized multiple times. Using the phrases that were categorized into their respective themes, we were able to further explain each construct's composition and count the occurrences. The enfolding literature step was used to connect the literature to the findings from the research. This step involved determining what is similar and conflicting, and why such variances exist. By making the connections, we could assure that the results are correct and descriptive.

Results

After an analysis of the data, it was apparent that the literature-provided constructs required modification. Whereas some of the constructs found in the data were similar to the literature (stakeholders, objective, governance, methods, openness), new constructs (funding, values, communication, infrastructure) turned out to be useful in understanding living labs (Table 1). Appendix 1 (Figures 1 to 7) illustrates the relative occurrences of scope within each emergent construct.

Objective

The studied living labs develop innovations by the communal effort of various actors (Collaboration). They prioritize teamwork and establish joint operations to mutually manage incubation space, state-of-the-art technology, and knowledge databases for optimal creativity, cost-reduction, and ecosystem. They pursue social impact on regions by improving citizen involvement in the community, developing technologies that better meet the needs, and building up urban infrastructures. Moreover, living labs offer business development to companies by creating resources and services (e.g., product research, incubation space, market trend analysis, and education). They foster employment and entrepreneurship (Economic Development), the creation of customized and holistic solutions, and the development of digital infrastructure. Lastly, living labs provide test beds and a framework for experimenting and testing products in real settings with users (Figure 1).

Governance

It was difficult to identify a specific governance structure for living labs, but the responsibilities of governance group include: setting the lab's vision, making investment

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Table 1. Emergent constructs from living lab cases

Construct	Definition	Scope
Objective	The positive impact that the innovation output is expected to produce	Collaboration, social impact, business development, economic development, user impact, test bed
Governance	A structural or procedural model by which decisions for the innovation projects, process, or organization are made	Managerial process, managerial structure
Openness	Mindset of the organization that is reflected in their level of openness and collaboration	Innovation culture, intellectual property rights
Stakeholders	Entities that add value to the living lab	Participants and their role
Funding	The means by which the living lab financially supports its innovation activities	Public funding, private funding, revenue stream of living lab's business model
Values	The benefits the stakeholders gain from their membership and participation within the living lab	Product outcome, social value, business development, validation, resources, networking, knowledge, investment, and marketing
Communication	The channels, technology, and techniques used to network stakeholders for information exchange	Online presence, media presence, person-to-person interaction
Infrastructure	The necessary resources and specialized equipment required to carry out the innovation activities	Software tools, hardware, sensors, facilities
Methods	The procedural steps used for the inception, development, and deployment of innovation	Attracting participants, ethics, motivational rewards, user support, data collection, idea generation, design, testing, and commercialization

decisions, managing IP, organizing activities, appointing roles, maintaining living lab infrastructures, and planning research. The governance group ensures that the activities meet the goals by monitoring the performance of the living lab. They take on the administrative and managerial work. The governing group is also responsible for the project-level decisions. They select the projects to pursue and assign the appropriate members to oversee and run the activities and create user-centric research methodologies. The legal forms of living labs in their respective order of highest occurrence are: private, public–private partnership, public–private–people partnership, public, and undefined (Figure 2).

Openness

The methods of managing IP in living labs are: consortium agreement, OEM, licenses, open source, case-by-case, law, and other. Living labs set forth rules and regulations regarding the use, sharing, and licensing of IP prior to the initiation of a project within the consortium agreement. The agreements can outline the distribution of cost and gains for each member depending on their role and investment in the developments. These set of rules must be signed by all members. Living labs can also give the originators (OEM) full rights to determine the extent of the IP's usage or to manage IP for each project between the participating members. The innovation culture in living labs encourages collaborative work to achieve innovation and other goals. Thus, living labs ensure that the members respect one another and share knowledge. They reduce barriers through free access to knowledge and use open standards to enable integration and access to free tools (Figure 3).

Stakeholders

Stakeholders could not be efficiently analyzed because the data were not properly formatted for content analysis in this respect. However, subjective review of the cases suggested the diverse involvement of companies, universities, unions, governments and public bodies, financers, civic organizations, and associations.

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Funding
The majority of funding in living labs comes from government grants and private investments. In addition, consulting provides revenues when the living lab receives payment for services rendered to third parties. The services offered in living labs vary because each living lab has a different focus. Living labs offer consulting including digital marketing, data collection and analytics, training, and product evaluations. Moreover, living labs produce income from their outputs in the form of royalties and sales. However, the members only make a profit when they succeed in the commercialization of the products. Living labs also lease their resources such as facilities and equipment to third parties for event purposes, lab research, or development (Figure 4).

Value
Living labs offer various benefits to their members: business development, knowledge, resources, networking, validation, marketing, social value, and investments. Supportive activities aid living lab members to achieve business goals (Business Development). Members benefit from management support, advisory teams, project development, other member's experiences/expertise, and education. Members can take advantage of living lab's research facilities, incubation space, technologies, and knowledge content. Members can make new connections to access new industries or markets. Through the structured process that enables collaborative work (Framework), living labs help accelerate the development of products at low cost, higher quality, and establish an initial market presence. Their associated activities and ecosystem create visibility for members' brands, and add legitimacy to members' businesses (Figure 5)

Communication
Two-way communication aims at achieving open dialogue for collaborative work in living labs, and helps for brainstorming ideas and gaining feedback from members. Living labs also need to consistently update the members of their progress and ongoing activities. Living labs use communication for self-promotion to brand, legitimize, and gain public recognition. Furthermore, the technology used for communication serves as management tools, for example, a database for hosting shared content, tracking project tasks, and collecting and appraising ideas. Figure 6 shows the online, media, and in-person modes of communication.

Infrastructure
Living labs have five types of infrastructure necessities: facilities, networks, hardware, software, and sensors. Again, the data were not properly formatted in order to codify and illustrate the infrastructure in our case living labs. However, all examined living labs appear to have facilities, dedicated or shared, to host in-person activities such as events, workshops, and testing in a test-bed. Facilities are either owned by the lab or a stakeholder who permits their use. Information technology infrastructure (networks) includes servers used to host the web technologies and data that facilitate collaboration. Hardware, software, and sensors vary from lab to lab depending on their intended use. In particular, sensors are used within the test environment for observing user behaviour and collecting usage data.

Methods
Living labs gain users from associations, events, and random sources such as hot-spots or housing authorities. Before their involvement, the living lab informs the users of their role and project objectives, and gain written, voluntary consent. Using lead users as influencers, and with extrinsic rewards, the living lab motivates the users to contribute to the project. The living lab also provides training and tools. During the idea generation, the users and other members discuss problems, brainstorm solutions, and set initial requirements. Universities and small companies often convert the requirements into designs and prototypes. Under the guidance of research experts, the solutions are tested with users in real-life environments where data is collected through monitoring technology, digital activity logs, and surveys/interviews. Academics then analyze the data to understand the impact of the solutions. Living labs often leave the commercialization efforts to companies but can use its ecosystem and experts to promote and adopt the solutions (Figure 7).

Conclusion

The nine constructs (objective, governance, stakeholders, openness, funding, value, communication, infrastructure, methods) provide a multi-faceted perspective to understanding living labs. Although such constructs could be considered common to innovation platforms in general, they provide a thematic perspective to examining and describing living labs that could be later compared to other innovation platforms. Using the constructs, we can now define living labs in a new manner:

> *"A living lab is a sociotechnical platform with shared resources, collaboration framework, and real-life context, which organizes its stakeholders into an innovation ecosystem that relies on representative governance, open standards, and diverse*

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> *activities and methods to gather, create, communicate, and deliver new knowledge, validated solutions, professional development, and social impact."*

The new definition of living labs differs from the well-accepted definitions in the literature, for example, that of Leminen and colleagues (2012) but warrants itself on three rationales. First, the new definition explicitly conceptualizes nature of living labs as *sociotechnical platforms* including *shared resources, collaboration framework,* and *real-life context.* The study proposes that living labs blossom or build up within a sociotechnical platform, assuming shared resources and collaboration (framework), which is realized in the chosen real-life environment. Second, the new definition assumes that a living lab organizes stakeholders and innovation activities into an *innovation ecosystem,* thus such innovation ecosystem may incorporate a high diversity of active and passive stakeholders, innovation structures, and networks. Third, the new definition broadens the outcomes of living labs from new technologies, services, products, and systems to *new knowledge, validated solutions, professional development,* and *social impact.* The definition explicitly incorporates also the sparsely discussed perspective of innovation, namely the intangible nature of innovation outcomes such as professional development and social impact in living labs. New knowledge refers to identified problems, ideas for solutions, novel information, content generation, and (scientific) discoveries. Validated solutions include the co-creation, testing, and validation of solutions.

At the same time, we reckon that one must exercise caution with the new definition. A recent literature review of living labs by Westerlund, Leminen, and Rajahonka (2018) applied topic modelling on a set of 86 living lab publications between 2011 and 2017 in the *Technology Innovation Management Review,* and identified various research perspectives on living labs. In this process, certain constructs of living labs surfaced upon the interpretation of the results. Conversely, the present study analyzed a sample of European Network of Living Labs (ENoLL) membership applications from 2011–2012, tapping into the key constructs that living labs reflect in their self-assessment. Thus, our analysis underlines the self-claimed nature of the identified constructs, and it stresses that they are crucial for living labs upon starting the operations and pursuing ENoLL accreditation. However, such constructs may not come up similarly in more established living labs or when the profiling description of a living lab is written by a researcher, as evidenced by the extant studies (cf. Leminen, 2013; Leminen, Turunen, & Westerlund, 2015; Leminen & Westerlund, 2012; Leminen, Westerlund, & Nyström, 2012).

Although the new definition of living lab platforms is based on an analysis of how living labs describe themselves in public documentation, it is a significant contribution to the current literature. The study provided further knowledge of the constructs that give rise to the definition. That is, common constructs drawn from streams of innovation-related literature (i.e., user innovation, co-creation, and living labs) that are associated with living labs were only partially supported by the empirical study. For instance, the empirical study revealed nine key constructs as opposed to six derived from the literature review, and only three of them matched perfectly. Moreover, the study revealed communication as an important construct that previous research has not emphasized (cf. Mulder et al., 2008).

Surprisingly, the study did not highlight stakeholder roles, user engagement, and real-life contexts as the key constructs of living labs (cf. Leminen et al., 2015a; Nyström et al., 2014). This may be related to the fact that applications reflected an early stage of living lab activity, and that the study searched for common aspects within the three literature streams, whereas real-life context is a unique aspect of living labs. That said, the present study helps researchers, entrepreneurs, and managers understand the advantages of living labs (business development support, access to resources and partnership networks, as well as product ideas, validation, and commercialization), and join a living lab that provides a particular benefit. Finally, stakeholders may look at the implications of each construct and theme to form living labs that best suits their goals and is aligned with their society/stakeholders to optimize their innovation process.

Limitations of the research included a restricted number of analyzed cases due to resource constraints and the fact that we narrowed down to 40 applications using strict criteria. A larger dataset could refine the discovered constructs as descriptors of living labs and lead to a more detailed explanation of the results. It may be argued that the sample of European Network of Living Labs (ENoLL) membership applications from 2011–2012 may be too old to analyze the construct of living labs. However, based on our best knowledge, the literature on living labs does not provide evidence that the recent living labs (as reflected in applications) would be significantly different from the previous ones

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by their maturity or their knowledge levels; this is no doubt given that many of such living labs are only starting their operations and lack first-hand experience. Hence, more research would be needed to examine whether there may be differences between a new dataset and the 2011–2012 dataset used here.

Interpretation of the data is dependent on the researchers' understanding of the subject. Thus, content analysis was used to limit the bias of human interpretation. However, codifying a semantic category counter based on the frequencies of occurrences is difficult due to the diversity of the cases. Data that are nouns, such as names, require additional work to determine their equivalent pronoun (e.g., user, designer). This problem occurred for the infrastructure and stakeholder constructs. This issue may also be related to the fact that we were unable to identify living labs where users are in a dominant role (cf. Leminen, 2013; Leminen, Rajahonka, & Westerlund, 2017). The data requires extensive formatting prior to analysis, which means heavy investment of time and effort.

We propose the following future work to be done: 1) the discovered constructs could be confirmed using a larger set of data, 2) future researchers could focus on the individual constructs to deepen the knowledge of living labs, 3) the constructs may be applied to other innovation concepts to examine unique patterns in those concepts, 4) further studies are needed to reveal typical living lab constructions, both mature and existing living labs but also recent living labs that are applying for their accreditation, 5) additional studies are needed to show relative importance and relationships between the suggested constructs in the diversity of living labs, and 6) other types of data should be incorporated to avoid cause-and-effect problems associated with analyzing characteristics of members based on their membership applications.

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About the Authors

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Seppo Leminen is a Research Director at Pellervo Economic Research in Finland, and he serves as an Adjunct Professor of Business Development at Aalto University in Helsinki, Finland, and as an Adjunct Research Professor at Carleton University in Ottawa, Canada. He holds a doctoral degree in Marketing from the Hanken School of Economics in Finland and a doctoral degree in Industrial Engineering and Management from the School of Science at Aalto University. His research and consulting interests include living labs, open innovation, innovation ecosystems, robotics, the Internet of Things (IoT), as well as management models in high-tech and service-intensive industries. He is serving as an associate editor in the *BRQ Business Research Quarterly,* on the editorial board of the *Journal of Small Business Management,* as a member of the Review Board for the *Technology Innovation Management Review,* and on the Scientific Panel of the International Society for Professional Innovation Management (ISPIM). Prior to his appointment at Aalto University, he worked in the ICT and pulp and paper industries.

Christ Habib is an MASc graduate from the Technology Innovation Management program at Carleton University in Ottawa, Canada. He also holds a BEng in Biomedical and Electrical Engineering. Christ has experience working in the public and private sectors, working closely with clients and managing large-scale projects; he has been offering management-consulting services for SMEs; and he is currently a systems engineer at General Dynamics. He is passionate about business development; systems, processes, operations, marketing, and analytics; and understanding user/client needs for innovation development. He was awarded the engagement leadership award by popular vote through the Mindtrust program for his facilitation skills in managing collaborative work.

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Appendix 1. Illustrations of the Results

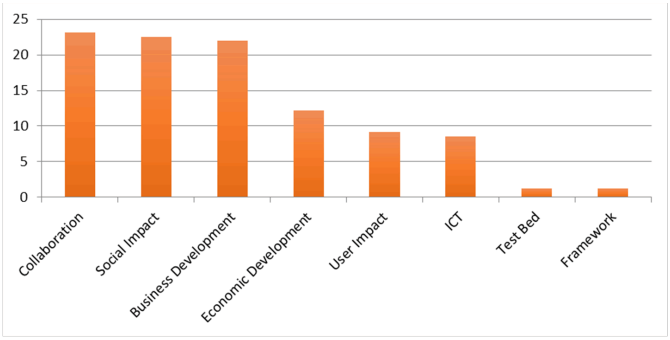

Figure 1. Objective

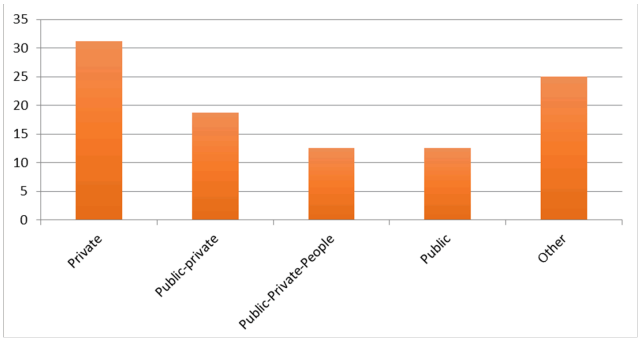

Figure 2. Governance

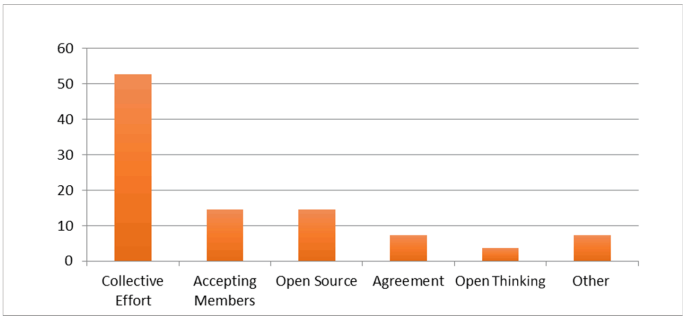

Figure 3. Openness

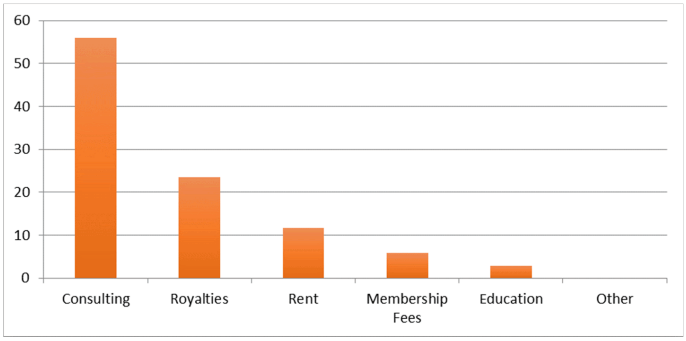

Figure 4. Funding

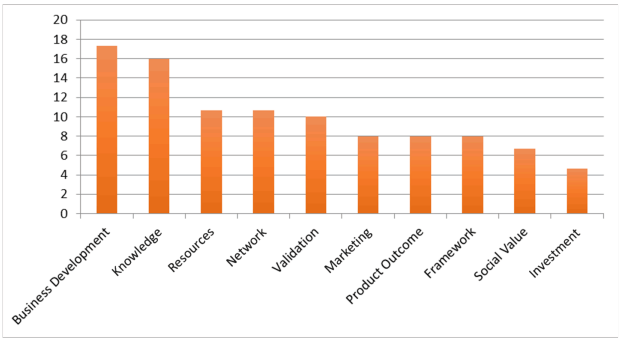

Figure 5. Value

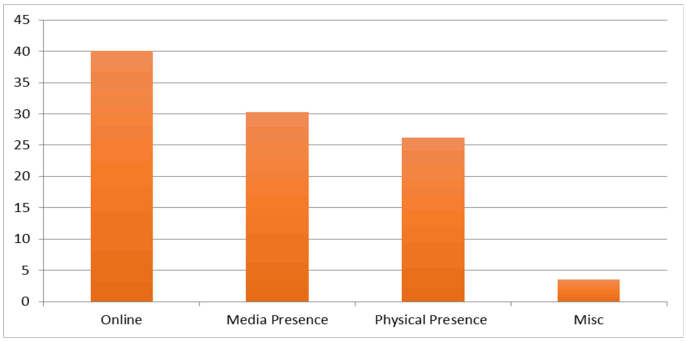

Figure 6. Communication

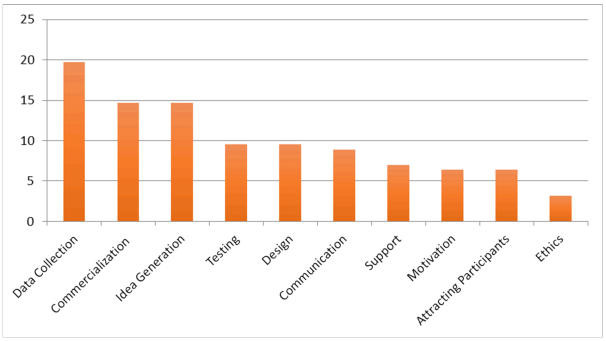

Figure 7. Methods

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