Living Lab Research: A State-of-the-Art Review and Steps towards a Research Agenda

Research-in-progress

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Abstract

Despite the fact that Living Lab research has been established as a very active research area within both Innovation Management (IM) as well as Information Systems (IS) literature, previous studies still lack consensus about what can be considered as a Living Lab activity and the concept of Living Lab has been interpreted in many different ways. The aim of this research-in-progress paper is to understand the current state of the art in the area of Living Lab research and to identify the key challenges and potential research opportunities within this field. In doing so, a literature review has been conducted, covering 26 studies on Living Lab research in both IS and IM literature. The main findings of this literature review in relation to identified challenges and future research opportunities are summarized in four main themes, namely, theoretical and methodological challenges, governance and process-related challenges, actors' motivations, needs and expectations and finally ethical challenges. The outcome of this study will thus be a research agenda to further our knowledge about the current challenges and future directions of Living Lab research.

Keywords: Living Lab, Literature review, Challenges, Research agenda

1.   Introduction

Nowadays, Living Labs have become a very popular research topic in both Information Systems (IS) as well as Innovation Management (IM) literature. Living Labs can be seen as an approach to manage open innovation in the process of IT-system development, where individual users are involved to co-create, test and evaluate digital innovations in open, collaborative, multi-contextual and real-world settings (Bergvall-Kareborn, Holst, and Stahlbrost, 2009; Ståhlbröst, 2008).

In contrast with the traditional research and development projects where the prototyped product, service or system is in focus (Brønnum & Møller, 2013), Living Labs present an outstanding approach where the focus is on user-driven and co-creative innovation (Ingrid Mulder, 2012). Despite this, previous studies lack consensus about what can be considered as a Living Lab activity and the concept of Living Lab has been interpreted in many different ways. As an example, by investigating 90 Living Lab activities in order to identify the key characteristics of an urban Living Lab, Steen and van Bueren (2017) argue that the majority of these activities that labelled themselves as Living Lab are not very different from traditional system development process; because they don't include one or more key characteristics of Living Lab activities. One plausible explanation may lie in the lack of strict objectives in the beginning of the Living Labs projects or activities (Leminen & Westerlund, 2012), or the dearth of research on a generic and harmonized instructions for the available Living Lab methods and tools (Ingrid Mulder, 2012). Such examples highlight the need for further research in order to better understand the current state of the art in the area of Living Lab research that enables researchers to identify the challenges and research opportunities that are waiting to be tackled; which is the main aim of this study. In so doing, within this research-in-progress, a comprehensive literature review has been conducted, covering studies on Living Lab research in both IS and IM literature. The outcome of this study will thus be a research agenda to further our knowledge about the current challenges and future directions of Living Lab research.

2. Methodology

As mentioned, the aim of this research-in-progress is to understand the current state of the art in the area of Living Lab research and to identify the challenges and potential research opportunities within this field. In this research-in-progress paper, an exploratory review of available empirical and academic literature has been conducted. The literature review follows a concept-centric approach as outlined by Webster and Watson (2002). The concept-centric method was chosen as it allows me to systematically synthesize the literature and enables me to make an initial classification on the subject of the reviewed literature. As suggested by Webster and Watson (2002), instead of limiting the search to specific years or journals, it could be better to broadly search for the publications on the topic. Therefore, no time limitation on the publication date of the articles was used.

In order to identify relevant studies, the literature search process began by using two online databases namely, Scopus and Web of Science as these databases enabled me to easily search in the abstract and keywords and also they are more comprehensive compared to other online databases. Due to a growing number of Living Lab studies, and to avoid obtaining unnecessary results, this literature review was started by searching the title, abstract and keywords as recommended by Ryaz et al (2009). The literature search was done by finding the articles that have used the term "Living Lab" or "Living Labs" in their title. Then, the search was restricted to studies which used the terms "challenges", "challenge", "challenging", "issue", "issues", "research opportunity", "research opportunities", "research agenda", "research direction", "research directions" and "future research" in their abstract and keywords. An additional manual search was also made within the top related journals and conferences within the Living Lab field (e.g., TIM Review journal, ISPIM conference, Open Living Lab Days, etc.) by considering the title and abstract of the articles. This was done to make sure that valuable and relevant literature is not overlooked. The literature search then continued by reviewing the references of the publications identified in previous steps (backward search). Next to that, identification of the publications citing the key articles (forward search) was done. This process resulted in 54 articles. After that, the abstract, introduction and conclusion of these 54 articles were carefully reviewed by the author and 26 articles were selected for the final review. Only articles in English language were considered in this study.

Besides the literature search, and in order to gain better understanding of the current discourse and position of Living Lab research, a keyword analysis of the more recent Living lab articles was also done. In this phase, I was interested in knowing what main topics or fields are more highlighted in recent Living Lab publications and what disciplines and topics are more likely to employ Living Lab approach in their research. In this phase, Scopus database was used and the articles were sorted by publication date. Then, the more recent 200 articles were included in this analysis and the title, abstract and keywords of each article were carefully read by the author. This context analysis will enable me to identify the further research challenges in each domain and to understand whether there is any correlation between identified challenges and a specific domain.

3. Results

The results of the keyword analysis show that Living Labs are still seen as a test platform, while these two concepts have fundamental differences in nature (Schuurman et al., 2011). On the one hand, the commercial maturity of prototyped product, service or system in traditional testbeds is higher than Living Lab activities. On the other hand, Living Lab activities are usually conducted in an open environment in contrast to traditional testbeds that the test situation is under control. Figure 1. shows the results of the keyword analysis in the more recent 200 Living Lab literature, extracted from Scopus database. In order to avoid too many items, closely related items (e.g., field trials and test beds) were merged to one group.
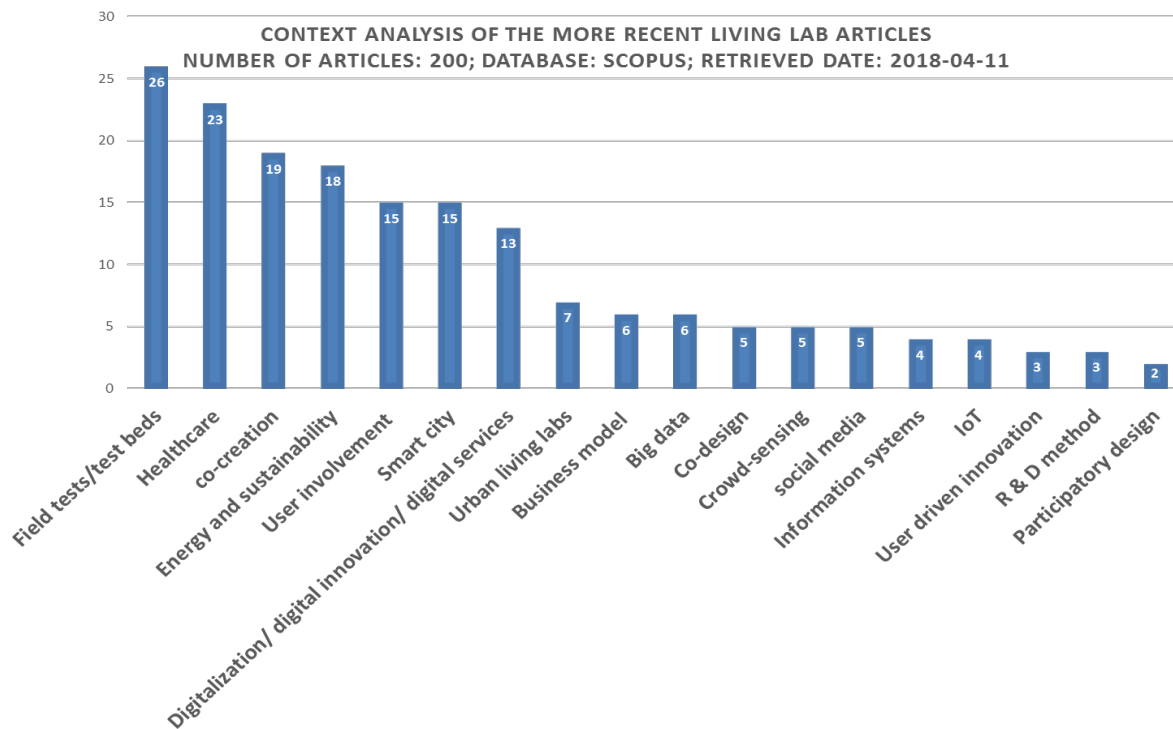
Figure 1.   *The results of the keyword analysis in the more recent 200 Living Lab literature, extracted from Scopus database.*

The main findings of this literature review in relation to identified challenges and future research opportunities can be summarized in four main themes, namely, theoretical and methodological challenges, governance and process-related challenges, actors' motivations, needs and expectations and finally ethical challenges. This categorization was done by coding similar items into coherent groups with a thematic relation. Each of these subcategories have sub-items as shown in Figure 2.
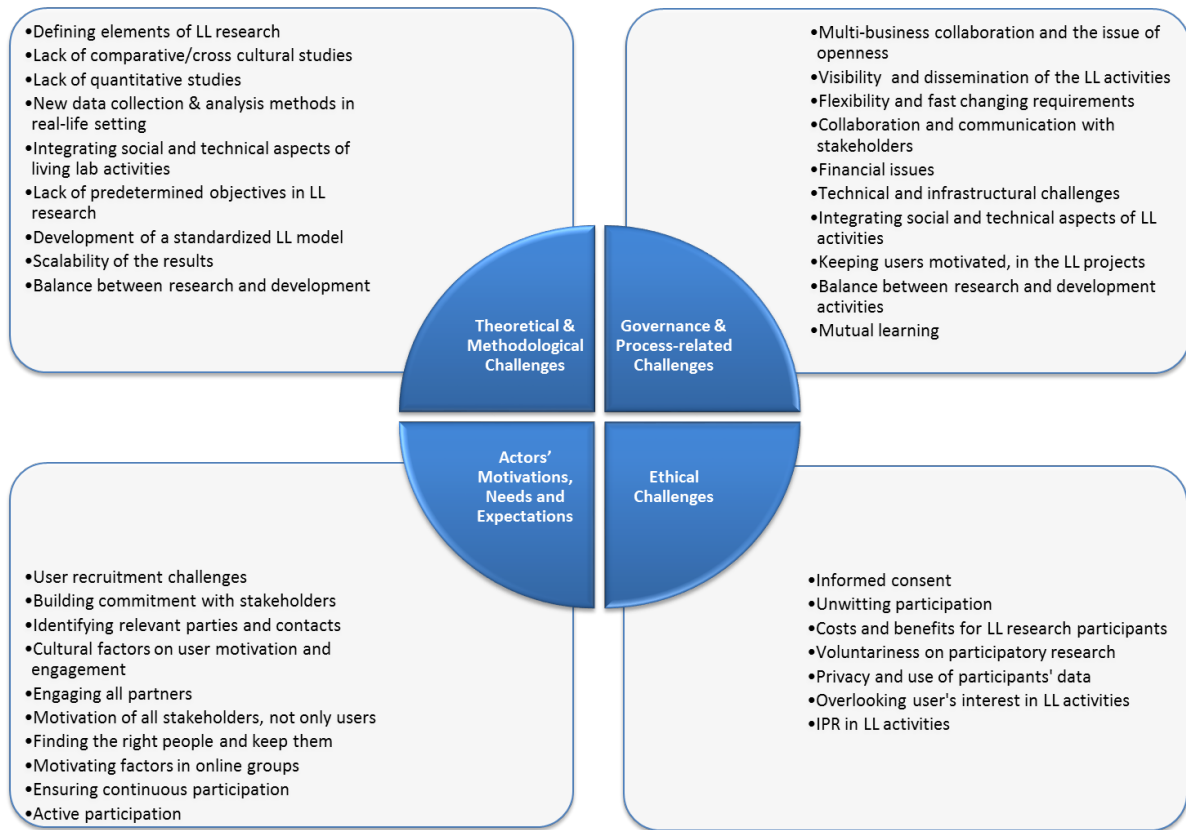
Theoretical & Methodological Challenges
- Defining elements of LL research
- Lack of comparative/cross cultural studies
- Lack of quantitative studies
- New data collection & analysis methods in real-life setting
- Integrating social and technical aspects of living lab activities
- Lack of predetermined objectives in LL research
- Development of a standardized LL model
- Scalability of the results
- Balance between research and development

Governance & Process-related Challenges
- Multi-business collaboration and the issue of openness
- Visibility and dissemination of the LL activities
- Flexibility and fast changing requirements
- Collaboration and communication with stakeholders
- Financial issues
- Technical and infrastructural challenges
- Integrating social and technical aspects of LL activities
- Keeping users motivated, in the LL projects
- Balance between research and development activities
- Mutual learning

Actors' Motivations, Needs and Expectations
- User recruitment challenges
- Building commitment with stakeholders
- Identifying relevant parties and contacts
- Cultural factors on user motivation and engagement
- Engaging all partners
- Motivation of all stakeholders, not only users
- Finding the right people and keep them
- Motivating factors in online groups
- Ensuring continuous participation
- Active participation

Ethical Challenges
- Informed consent
- Unwitting participation
- Costs and benefits for LL research participants
- Voluntariness on participatory research
- Privacy and use of participants' data
- Overlooking user's interest in LL activities
- IPR in LL activities

Figure 2.   The initial findings of the reviewed literature within the main four themes.

In the following, each of the main themes and its associated sub-items are discussed in greater details.

3.1   Theoretical and methodological challenges

The theoretical and methodological challenges are associated with the defining elements of LL research as well as the issues related with Living Lab research methodologies and approaches. Tables 1 and 2 show the initial results and direct quotations from the reviewed literature.

	Direct quote from the literature	Reference
1	Most of the projects that label themselves as living labs do not include all the defining elements of a living lab.	(Leminen, Rajahonka, & Westerlund, 2017)
2	Most living lab activities emphasize traditional user-centric lab methodologies, although it is the living part that makes a living lab an outstanding methodology for user-driven and co-creative innovation.	(Ingrid Mulder, 2012)
3	The assessment shows that the majority of the projects that are labelled as living labs do not include one or more of the defining elements of a living lab.	(Steen & van Bueren, 2017)

4	By all the definitions, a Living Lab has a different approach, mindset and process than a traditional R&D project, where the concept and product is in focus.	(Brønnum & Møller, 2013)
5	The living methods and tools in common use are heterogeneous and vary between different living lab sites; they can even vary across the services within one site. This might not be a problem once living methods become harmonized, and tools could make it easier to compare findings across living labs and allow for a wider uptake of living methodologies.	(Ingrid Mulder, 2012)

Table 1.   Identified challenges related to defining elements of Living Lab research

	Direct quote from the literature	Reference
1	There is also a lack of empirical, more quantitative and comparative studies that focus on the added value of Living Labs.	(Schuurman, De Marez, & Ballon, 2015)
2	A central problem of socio-technical design is the integration of technical functions with social structures and perspectives.	(Herrmann, 2009)
3	The lack of strict objectives in the beginning of the Living Labs project is also a challenge.	(Leminen & Westerlund, 2012)
4	analyzing social context data, application usage data and user experience data collected in real-life settings will present new challenges and asks for new methods of data collecting and data analysis.	(Ingrid Mulder, Velthausz, Strating, & ter Hofte, 2007)
5	Formulation and development of a standardised (multiple) Living Labs model. There are no generic instructions for the Living Labs method available.	(Leminen & Westerlund, 2012)
6	Scalability of results. This seems to be another concern. The area of influence of Citilab is quite small. with the resources available for the fab athenaeums, nothing will be solved. ideas and prototypes will be born but these will become important when they are externalized and they become bigger.	(Gascó, 2017)
7	That raises the dilemma of balancing for exploration and exploitation (research and development).	(Leminen & Westerlund, 2012)

Table 2.   Identified challenges related with Living Lab research methodologies and approaches

3.2   Governance and Process-related Challenges

When it comes to governance and process-related challenges, issues related with collaboration, interaction and dissemination are more highlighted in the reviewed literature. Moreover, technical, infrastructural and financial challenges can also be considered as governance and process-related challenges. Tables 3 and 4 illustrate the issues and challenges that can be categorized under this theme.

	Direct quote from the literature	Reference
1	One of the challenging issues of setting up a Living Lab is coping with multiorganizational collaboration between a wide variety of stakeholders including public, industrial and academic stakeholders.	(Winthereik, Malmborg, & Andersen, 2009)
2	A recurring challenge within PD concerns how to communicate the needs of users in such a way that developers can understand them while developers need to be able to feed back their understanding of system requirements in a manner such that the users can make sense of it.	(Bergvall-Kåreborn, Howcroft, Ståhlbröst, & Wikman, 2010)
3	Multi-business collaboration or multi-business agendas. It recognizes the potential conflicts and barriers for collaboration, which may come from contradicting interests, and at the same time being able to keep the Living Lab open to different, and perhaps even competing investments or business models, while managing and facilitating the collaboration.	(Brønnum & Møller, 2013)
4	In addition, building trust and operational transparency is a necessity. It is a challenge for organisational participants because they should be open about their knowledge yet maintain secrecy about their internal issues at the same time.	(Leminen & Westerlund, 2012)
5	However, they are not known by citizens, its main target group. Probably due to the little human resources involved in the project, there has not been a chance to work on dissemination. But, also, despite its philosophy, a fab athenaeum is still perceived as a place for technology experts. Although several activities have been organized in the fab athenaeums, a network of people and organizations (the fab athenaeums community) has not been developed around these activities. According to one of the interviewees, this has hindered visibility.	(Gascó, 2017)

Table 3.   Issues related with collaboration, interaction and dissemination

	Direct quote from the literature	Reference
1	In this case, nevertheless, an overall agenda is necessary in order to coordinate LIVING LABs on a European level, safeguarding the advantages of a European network, e.g. mutual learning, economies of scale and flexibility in the light of fast changing requirements in user-centred innovation research.	(Liedtke, Welfens, Rohn, & Nordmann, 2012)

2	The Living Labs network should be flexible and adapt to rapid changes, but at the same time it should be able to guarantee its stability to the participants. Flexibility means that participants are able to participate in the network or leave at any time.	(Leminen & Westerlund, 2012)
3	the challenges that lie in the actual setting up of a LivingLab in terms of resources and infrastructure	(I. Mulder et al., 2008)
4	This is another frustration both for civil servants and for those actors that economically support Citilab. It is very expensive to open the building each day.	(Gascó, 2017)
5	That raises the dilemma of balancing for exploration and exploitation (research and development).	(Leminen & Westerlund, 2012)
6	The innovation process matters more than the specific innovations. Sustainability and scalability of results are a concern	(Gascó, 2017)

Table 4.   Technical, infrastructural and financial challenges

3.3   Actors' Motivations, Needs and Expectations

The initial results of reviewing literature revealed that several challenges in Living Lab research might be associated with the actors' motivations, needs and expectations. These issues are included but not limited to motivational factors, recruitment challenges and active participation of different stakeholders within the development and innovation process. The main identified issues and challenges in this theme are listed in table 5 and 6.

	Direct quote from the literature	**Reference**
1	There is not sufficient knowledge today with respect to motivating factors in online groups, which are composed of voluntary contributors.	(Ståhlbröst, Bertoni, Følstad, Ebbesson, & Lund, 2013)
2	To extract the best of a LivingLab, people have to be encouraged to be active participants in the processes and this encouragement can be tricky due to the varied cultural leanings.	(Bagalkot, 2009)
3	When it comes to testing a digital innovation, previous studies show that the users' motivation in an open innovation environment such as living labs, especially at the beginning of the test is higher than the rest of the activity and the users tend to drop-out of field test before the project or activity has ended.	(Habibipour, Padyab, Bergvall-Kåreborn, & Ståhlbröst, 2017)
4	how different stakeholders should be motivated in order to be engaged in the development and innovation processes in collaborative innovation networks, and on what actions are necessary to keep stakeholders engaged.	(Leminen et al., 2017)
5	the Living Labs face the challenges of setting and clarifying the conditions of user participation.	(Winthereik et al., 2009)

6	Ensuring continuous participation and expressing relevant experiences is another challenge.	(Leminen & Westerlund, 2012)

Table 5. *Challenges related with the motivational factors*

	Direct quote from the literature	**Reference**
1	I seek a much more active role for users in a LivingLab. I understand 'co-creation' as an active involvement of users in the design activity of creating artifacts, beyond just contributing to the 'need requirements' and 'evaluation' phases.	(Bagalkot, 2009)
2	In current Living Lab practices users are seen more as sources of (predefined) technology use, rather than sources of innovation.	(Winthereik et al., 2009)
3	Firstly, finding the right people, and keeping them, is one of the most critical factors to sustain Living Labs.	(Kang, 2012)
4	All partners should engage in the forming of the Living Lab if possible, to ensure the commitment and the shared understanding for the scope and purpose of the Living Lab.	(Brønnum & Møller, 2013)
5	For innovation to occur, identifying relevant parties that might produce an innovation together, in a joint problem solving process, is a necessary first step.	(Mensink, Birrer, & Dutilleul, 2010)
6	The whole network should depict the benefits of the Living Labs innovation model to current and potential utilisers and financing bodies.	(Leminen & Westerlund, 2012)

Table 6. *Issues related with recruitment challenges and active participation*

3.4   Ethical Challenges in LL activities

The fourth category of identified challenges are associated with ethical challenges in Living Lab processes. These challenges might be related to the user engagement approach, informed consent, Privacy and use of participants' data, overlooking user's interest in Living Lab activities, IPR in Living Lab activities, unwitting participation and Voluntariness on participatory research processes. These ethical issues are summarized in tables 7 and 8.

	Direct quote from the literature	**Reference**
1	The availability of physiological and psychological monitoring in personal environments has a potential negative impact such that all testing must observe the legal rights of the tested participants.	(Korman, Weiss, & Kizony, 2016)
2	In theory it might be possible to opt out of the experiment (…) in practice it is unlikely that you would be able or willing to do so.	(Mensink et al., 2010)

3	Problems may evolve with regard to the necessity to obtain full, long-term confidential information and filtering of information that the user does not wish to have released (e.g. personal life events or some aspects of health information), easily creating an unintended violation of a user's privacy.	(Korman et al., 2016)
4	It is not enough to get permission from people; they need to know what they are being asked to participate in so that they can make an informed decision.	(Hindus, 1999)
5	From a user's rational standpoint, the costs of participation are real, whereas the benefits they might derive from the products developed in Living Labs are uncertain.	(Mensink et al., 2010)
6	informed consent is trickier for homes, because of the presence of children and the centrality of children to home life.	(Neuman, 2002)

Table 7.   Issues related with informed consent and citizen engagement in Living Lab activities

	Direct quote from the literature	Reference
1	Living Labs seem to operate with the implicit assumption that users are cheap or unpaid contributors, motivated by the anticipation that their participation will solve their problems or lead to 'better' designs.	(Ingrid Mulder & Stappers, 2009)
2	An area of importance when bringing the citizens/consumers into the Living Lab innovation system described is how to handle the ethical and IPR issues. As private persons become a source of ideas and innovations, there should be an appropriate rewarding and incentive system in place that secures pay-back to all the actors involved.	(Eriksson, Niitamo, Kulkki, & Hribernik, 2006)
3	Users might have to join to the group activities due to group pressure despite the fact that their participation is defined as "voluntary".	(Löfman, Pelkonen, & Pietilä, 2004)
4	Sometimes privacy is inadvertently invaded, and both the researchers and volunteers might feel that some information about them pertains to a specific relationship, a relationship that entitles the other side to inquire about such facts.	(Sainz, 2012)
5	Finally there are some ethical aspects in relation to the user, which have to be taken into consideration i.e. voluntary involvement of the user or the potential mismatch between asking the user to share personal knowledge and at the same time having business partners in the Living Lab, who do not wish to share their knowledge.	(Brønnum & Møller, 2013)
6	This pressure to participate can make it difficult for the voluntary contributors to withdraw from the activity or refuse to participate.	(Sainz, 2012)

| 7 | Problems may evolve with regard to the necessity to obtain full, long-term confidential information and filtering of information that the user does not wish to have released (e.g. personal life events or some aspects of health information), easily creating an unintended violation of a user's privacy. | (Korman et al., 2016) |

Table 8.   *Challenges related to voluntariness of participation, privacy and human rights in Living Lab activities*

As it can be seen, all of these four themes have been paid almost enough attention by the reviewed literature. To summarize, table 9 shows how many papers belong to each main theme. It is worth noting that in some cases, one article can belong to more than one theme.

	Theme	Number of papers
1	Theoretical and methodological challenges	9
2	Governance and process-related challenges	9
3	Actors' motivations, needs and expectations	11
4	Ethical challenges in Living Lab activities	10

Table 9.   *Number of papers in each theme*

4. Discussion and conclusion

The results of this research-in-progress will open up several avenues for future studies within the area of Living Lab research. There is a clear need to strike a balance between research and development, as the current studies are more focused on practical challenges and theoretical and methodological research has remained unchallenged. Moreover, further research is required in order to understand the challenges related to data collection in a Living Lab setting where the users are involved in their real-life situation. Furthermore, I do believe that there is a need to distinguish among different kind of Living Labs (e.g., ordinary Living Labs and Urban Living Labs) and their key elements and characteristics.

Regarding the governance of Living Labs, several questions still remain unanswered. Such an example would be to investigate how a multi-directional collaboration between various partners and individuals should be built on and how a trustful relationship between the wide variety of stakeholders should be established. The financial and infrastructural challenges are also highlighted in the reviewed literature.

Although several research has been undertaken to understand how to motivate individuals to participate in the user studies, there is a dearth of research on what the Living Lab organizers should do and how they should act in order to keep users motivated particularly within an open environment (such as Living Lab) that the participation is usually voluntary.

Last but not least, ethical challenges in relation to voluntariness of users' participation, unwitting participation, informed consent, overlooking the participants' interests, costs and benefits of their participation and finally the ethical interaction with the research participants throughout the process of user engagement in the Living Lab activities were more highlighted within the reviewed literature.

An interesting topic for future research would be to understand the degree of importance of each group of challenges and more importantly, which challenges should be tackled first. I do hope that the results of this research-in-progress will present several exciting research opportunities for Living Lab researchers. On the other hand, further analysis of the reviewed literature will enable Living Lab managers to gain a better understanding of the potential challenges that they may face while setting up and running a Living Lab project.

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