DROP-OUT IN LIVING LAB FIELD TEST: ANALYSING CONSEQUENCES AND SOME RECOMMENDATIONS

Research paper

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Abstract

Involving individual users in the process of information systems development is a key dimension of open innovation. Living Labs are socio-technical systems that facilitate information systems development by integrating technical, social and organizational structures and focusing on individuals, tasks, technologies and the interactions between different stakeholders. Testing digital innovations in real-life use context is one of the key components of Living Labs. The users' motivations to participate in Living Lab field tests at the beginning of the project are usually higher than once the field tests are underway. However, there is a dearth of research on other issues related to participants' drop-out in Living Lab field tests. This study contributes to the existing literature by investigating the consequences of drop-out in Living Lab field tests and providing recommendations that would facilitate prolonged user engagement. The paper also discusses some ethical considerations regarding involvement of participants within Living Lab field tests. In doing so, we interviewed fourteen Living Lab experts in two Living Labs in Sweden and Belgium. Based on these interviews, we propose a first set of consequences, recommendations and ethical considerations to take into account when setting up Living Lab field tests.

Keywords: User engagement, Drop-out, Living Lab, Field test, Recommendations, Ethics

1 Introduction

Involving individual users in the process of information systems development is a key dimension of open innovation that contributes positively to new innovations as well as system success, system acceptance and user satisfaction (Bano and Zowghi, 2015; Leonardi et al., 2014; Lin and Shao, 2000). Individual users are also considered as one of the most valuable external sources of knowledge and a key factor for the success of open innovation (Jespersen, 2010). Living Labs are one of the more recent approaches of managing 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). A major principle within Living Lab research consists of capturing the real-life context in which an innovation is used by end users by means of a multi-method approach (Schuurman, 2015). Testing a product, service or system is one of the key components of the Living Labs (Claude et al., 2017; Thapa et al., 2014). In a Living Lab setting, a field test is a user study in which test users interact with an innovation in their real-life everyday use context while testing and evaluating it (Georges, Schuurman, and Vervoort, 2016). As digital innovations are one of the key aspects of Living Lab activities (Bergvall-Kåreborn, Eriksson, Ståhlbröst, and Svensson, 2009), we will focus in this study on digital products, services or systems when it comes to Living Lab field tests.

However, regarding 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 process (Ley et al., 2015; Ogonowski, Ley, Hess, Wan, and Wulf, 2013; Ståhlbröst and Bergvall-Kåreborn, 2013). Consequently, the users tend to drop-out of field tests before the project or activity has ended as the motivations and expectations of the users will change over time (Georges et al., 2016). This drop-out might be due to internal decision of the participant to stop the activity or external environmental factors that caused them to terminate their engagement (O'Brien and Toms, 2008) and is occurring in all phases of the innovation process, from contextualization to test and evaluation (Habibipour, Bergvall-Kareborn, and Ståhlbröst, 2016). As defined by Habibipour, Georges, Schuurman, and Bergvall-Kåreborn (2017) and applied in this study, a participant is considered as dropped out when he/she has signed up to participate in the Living Lab field test, but does not complete all the assigned tasks within the specified deadline.

A number of studies have acknowledged the importance of sustainable user engagement in the Living Lab activities (Hess and Ogonowski, 2010; Leonardi et al., 2014; Ley et al., 2015). As those users already have a profound understanding and knowledge about the activity or project (Hess and Ogonowski, 2010), they are able to provide deeper and more detailed feedback (Ley et al., 2015; Visser and Visser, 2006). Moreover, a trustful relationship between the users and developers has already been established and it is positively associated with the project results (Carr, 2006; Jain, 2010). Finally, drop-out in projects is costly in terms of both time and resources as the developers need to train new users and provide an adequate infrastructure (such as hardware, software and communication technology) for them (Hanssen and Fægri, 2006; Ley et al., 2015).

Although keeping users motivated throughout Living Lab field tests is more challenging than motivating them to start participating (Ley et al., 2015; Pedersen et al., 2013), the literature still lacks an understanding of the consequences and implications of drop-out and necessary actions that Living Lab organizers should do to reduce the likelihood of drop-out in field tests. Accordingly, the aim of current study is to gain insight into the possible consequences of drop-out in Living Lab field tests with the objective to provide some recommendations that would facilitate prolonged user engagement throughout Living Lab field tests. In so doing, we interviewed fourteen experts in the area of Living Lab field testing.

The remainder of this paper is organized as follows. The next section presents the theoretical background for this study and reviews some related work. The subsequent section outlines the methodology and research process for this study. The results of this study regarding the drop-out consequences and some recommendations are presented in the fourth section and the paper ends with a discussion of the findings, together with suggestions for further research.

2 Theoretical Background and Related work

Information Systems (IS) field has a history of 60 years and originated and evolved from the Management Information Systems (MIS) discipline (Hirschheim and Klein, 2012). Since then, the significant progress of IS field has made it as an independent discipline that has its "own right" (Baskerville and Myers, 2002, p. 1) instead of a being a sub-category of MIS research. Subsequently, IS was recognized as a distinctive research discipline and many different research themes have been emerged within the area of IS. Examples of these research streams are IS adoption and diffusion, decision support systems, IS evaluation, IS development (ISD), etc.

Similarly to the field of IS, the theory of socio-technical systems has been around since 1960s when it was initially developed in order to improve and enhance the quality of life (Mumford, 2006). Socio-technical systems are generally known as the systems that "*comprise the interaction and dependencies between aspects such as human actors, organizational units, communication processes, documented information, work procedures and processes, technical units, human-computer interactions, and competencies*" (Herrmann, 2009, p. 336). Accordingly, socio-technical systems might consist of individual users, technical, social, cultural and organizational components (Pilemalm et al., 2007).

The integration of social structures and perspectives with technical functions is the central problem of socio-technical system design (Herrmann, 2009). One of the more recent approaches of designing and developing socio-technical systems are Living Labs that aim at integrating technical, social and organizational structures that are related to various stakeholders and their perspectives (McNeese et al., 2000). Therefore, Living Labs can be considered as socio-technical systems, as they allow to focus on individuals, tasks and structures, technologies and the interactions between different stakeholders (Schaffers et al., 2009).

According to Schuurman (2015), there are three different levels of analysis within Living Lab phenomena, namely, macro level, meso level and micro level. The macro level might be related to the research process in which the outcome is seen from the researchers' perspective for further analysis. Meso level is more related to the process of organizing Living Lab activities, methodologies and the participation approach as well as usefulness of the produced results. The micro level reflects on the project itself (e.g., conducted field test) as well as the prototyped innovation.

There are several different collaborative innovation networks such as Fab Labs, co-creation spaces, co-working spaces, hackathons and makerspaces (Capdevila, 2014; Leminen, Rajahonka, and Westerlund, 2017), and these innovation networks have many things in common with Living Labs. For example, real-life context is a key principle in all of these activities (Leminen et al., 2017) and all of them are driven by an open culture through a sharing attitude and a peer-to-peer approach (Capdevila, 2014). Despite this, these collaborative innovation networks have fundamental differences in their participation logics and behaviour compared to Living Labs (Capdevila, 2014). In a study of 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. Accordingly, due to the different principles and participation approach, Living Lab activities might not follow ethical issues that are considered in other collaborative innovation networks (Barcenilla and Tijus, 2012; Capdevila, 2014). Despite the fact that ethical considerations might have close ties to sustainable user engagement, we neither have found any literature that discusses ethical issues in relation to drop-out in Living Lab field test, nor even in a more general level in relation to sustainable user engagement. The traditional viewpoint of user participation in the development process (especially the process of information system development) highlights this fact that all people morally and ethically have this right to influence their own destiny (Bergvall-Kåreborn and Ståhlbrost, 2008). Therefore, they should be involved in this process since they usually will be the end-user or customer of that prototyped system or service. Moreover, this participation empowers the users from the point of view of democracy, where they are influential in the decision making process when it comes to design and development of an information system. However, the nature of involving people in traditional system development processes has fundamental differences with new approaches of user engagement such as Living Lab activities. In the Living Lab activities, participation must be totally voluntary (Mensink, Birrer, and Dutilleul, 2010) and the contributors may not necessarily be end-users or customers of the prototyped information system or service (Ståhlbröst and Bergvall-Kåreborn, 2013). These differences raise a number of ethical issues in involving individual users in open innovation activities including Living Lab field tests.

The fundamental premise of Living Lab activities is that individual users are involved to co-create, test and evaluate innovations in open, collaborative, multi-contextual and real-world settings (Bergvall-Kareborn et al., 2009; Leminen, Westerlund, and Nyström, 2012; Ståhlbröst, 2008). This approach is in line with open innovation, a term first coined by Chesbrough (2003). Within open innovation, external knowledge sourcing becomes a key function in open innovation (Bengtsson et al., 2015; Ghisetti, Marzucchi, and Montresor, 2015; Ooms, Bell, and Kok, 2015), and individual users as contributors in the innovation process have been seen as a valuable external resource (Jespersen, 2010). However, involving individual users in open innovation processes is challenging as the participants tend to drop-out of projects or activities before completing the assigned tasks.

In order to gain better understanding of the drop-out, Habibipour et al. (2016) carried out a comprehensive literature review to identify documented reasons for drop-out in information systems development processes. The authors in this study identified influential factors on drop-out behavior and classified them in three main areas of consideration: technical, social and socio-technical aspects. When it comes to technical aspects, the main reasons which lead to drop-out are related with the performance of the prototype such as task complexity and usability problems (instability or unreliability) as well as inappropriate preparation of participants to participate in the project or activity. Limitation of users' resources, inadequate infrastructure and insufficient technical support are other technical aspects. Regarding the social aspects, issues related with the relationship (either between users and developers or between participants themselves), lack of mutual trust and inappropriate incentive mechanism are the main reasons. In considering the socio-technical aspects, wrong user selection and privacy and security concerns were more highlighted in the studies. However, in the abovementioned study the authors did not focus on a specific phase or types of activity and extracted the drop-out reasons for all steps of the information systems development process such as ideation, co-design or co-creation and finally test and evaluation.

In another study, Georges et al. (2016) conducted a qualitative analysis within three Living Lab field tests to find factors that are related, either positively or negatively, to different types of drop-out during field tests. The field tests were carried out in Living Lab projects from iMinds Living Labs (now imec.livinglabs). The data in this study was collected via open questions in post-trial surveys of the field tests and an analysis of drop-out data from project documents. The results of this study show that several factors related to the innovation, as well as related to the field trial setup, play a role in drop-out behavior, including the lack of added value of the innovation and the extent to which the innovation satisfies the needs, the restrictions of test users' time and technical issues.

There has also been an attempt to present a user engagement process model that includes a variety of reasons for drop-out (Habibipour and Bergvall-Kåreborn, 2016). The presented model in this study is grounded on the results of a literature review as well as a field test in Botnia Living Lab in Sweden. In this model, influential factors on drop-out behavior are associated with: 1) task design such as complexity and usability; 2) scheduling such as longevity; 3) user selection process such as users with low technical skills; 4) user preparation such as unclear or inaccessible guideline; 5) implementation and test process such as inadequate infrastructure; and 6) interaction with the users such as ignoring users' feedback or lack of mutual trust.

As the first step of constructing a theoretical discourse on the field, Habibipour et al. (2017) presented an empirically derived, comprehensive taxonomy for the various influential factors on drop-out behavior in Living Lab field tests. According to their study, the drop-out reasons are mainly related to the innovation, the process of Living Lab field tests and the participants themselves. *Innovation-related factors* (i.e., technological problems, perceived ease of use and perceived usefulness) are the group of items that are associated with technology in which the innovation plays the central role in this theme. Regarding the *process-related factors*, the way of organizing the research, communication and interaction between different stakeholders, designing the tasks and timing are influential on drop-out behavior. When it comes to *participant-related items*, environmental context such as participants' everyday context and their resources are more influential on their drop-out behavior. Accordingly, participant-related factors are more related to their personal context.

Despite common characteristics between traditional socio-technical research and Living Lab research (such as, combining social and technical aspects), these two approaches have fundamental differences. On the one hand, within IS literature, socio-technical systems have an organizational focus (Herrmann, 2009) whereas Living Lab research relies heavily on open innovation approach and multi-directional flow of knowledge and experience between all stakeholders (including individual users). On the other hand, within traditional socio-technical research, an organizational leverage usually exists to secure user participation, while within the Living Lab approach, the user participation is voluntary, and the participants may not necessarily be end-users or customers of the prototyped system or service (Ståhlbröst and Bergvall-Kåreborn, 2013).

Although above mentioned studies have superficially addressed the importance of sustainable user engagement in a more general level, none of them have discussed the consequences of drop-out specifically in Living Lab field tests nor considered the viewpoint of experts in order to reduce the likelihood of drop-out in Living Lab field tests. The current literature also lacks an understanding of ethical considerations when it comes to user engagement in Living Lab field tests in general and dropped out participants in particular. In this study, we argue for the need to better understand these topics that enable the organizers to secure and sustain user engagement in Living Lab field tests.

3 Methodology

A qualitative research approach is chosen for this study because qualitative research is more appropriate when a detailed and systematic study needs to be conducted in the natural setting (Kaplan and Maxwell, 2005) and in a Living Lab field test, the users usually are engaged to test in their real-life every day setting. On the other hand, as recommended by social scientists, in order to promote stronger interaction between research and practice and obtain more reliable knowledge, different perspectives should be included in the study (Kaplan and Maxwell, 2005). This approach is in line with Van de Ven's (2007) recommendation to conduct social research which is labelled as "engaged scholarship". Engaged scholarship is defined as:

> "A *participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems. By involving others and leveraging their different kinds of knowledge, engaged scholarship can produce knowledge that is more penetrating and insightful than when scholars or practitioners work on the problem alone*" (p. 9).

The study was conducted as collaboration between two Living Labs namely, Botnia Living Lab and imec.livinglabs. Botnia Living Lab was founded in 2000 in Luleå University of Technology (LTU) in Luleå, a city in the north of Sweden. The aim of Botnia Living Lab is to engage end-users, individuals, and stakeholder organizations in an interactive and iterative process from need and idea generation through concept-development and prototype testing to market validation. Botnia Living Labs have experience from over 25 research and development projects and has a database of more than 6000 (potential) creative end-users.

Imec.livinglabs is the living-labs-as-a-service department of the imec research institute. Its activities started in 2005 as iLab.o, evolved into iMinds Living Labs and then became imec.livinglabs after the merger between the iMinds (ICT & media innovation) and imec (nanotechnology & hardware innovation) research institutes. Within this department, mostly bilateral Living Lab projects are set-up for start-ups, SMEs, large companies and public sector organizations, following the Living Lab principles of active user and stakeholder co-creation and real-life testing, making use of a panel of over 14000 end-users. Over 100 innovation projects have been finished.

Both Botnia and imec.livinglabs are effective members of the European Network of Living Labs (ENoLL - www.openlivinglabs.eu) and were the founders of the network in 2006.

We conducted fourteen semi-structured, open-ended interviews with experts in Living Lab field tests who hold different positions and responsibilities in both Living Labs. Six of them were Living Lab researchers and user engagement experts from Botnia Living Lab in Sweden and eight out of fourteen interviewees were user researchers or panel managers from imec.livinglabs in Belgium. These experts were selected as they were not only familiar with the Living Lab studies in general, but also they had extensive work experience in relation to conducting Living Lab field tests. Table 1 shows more information about the interviewees and conducted interviews. BS represents the experts from Botnia Living Lab in Sweden and IB represents the experts from imec.livinglabs in Belgium.

The results from this step were analysed separately in two groups in each Living Lab (i.e., Botnia and imec.livinglabs). Accordingly, in this study, we used investigator triangulation to increase the reliability as well as the validity of the results and greater support to the conclusions (Benbasat, Goldstein, and Mead, 1987; Flick, 2009).

During the interview, the interviewees were asked some open questions about the consequences of drop-out according to their experiences, their recommendations and suggestions to improve the field test process and reduce the likelihood of drop-out, and the ways that they consider to re-motivate dropped out participants which can also arise some ethical issues.

When it comes to analysis of the data, qualitative coding as the most flexible method of qualitative data analysis was used (Flick, 2009). The coding was done in three major steps. First, all the interviewees' verbatim assigned a unique code (i.e., “1” for drop-out consequences and implications, “2” for recommendations and suggestions). Second, redundant or similar quotations were combined and assigned the same code (e.g., “flexible deadline” and “open scheduling”, etc.). And finally, in order to properly analyse data and gain thorough insight, Microsoft Excel 2016 was used as a spreadsheet tool for combining coded data and information.

Interviewee code	Living Lab & Country	Responsibility	Living Lab experience	Number of involved field tests	Interview date	Length of interview
BS1	Botnia Living Lab, Sweden	Scientific Director	16 years	> 25	2017-03-07	70 minutes
BS2	Botnia Living Lab, Sweden	User engagement expert	2 years	3	2017-03-08	60 minutes
BS3	Botnia Living Lab, Sweden	User engagement expert	3 years	~ 10	2017-03-08	50 minutes
BS4	Botnia Living Lab, Sweden	General manager	13 years	~ 40 – 50	2017-03-10	75 minutes
BS5	Botnia Living Lab, Sweden	User engagement expert	8 years	~ 10	2017-03-16	55 minutes
BS6	Botnia Living Lab, Sweden	User engagement expert	6 years	~ 6	2017-03-04	55 minutes
IB1	Imec.livinglabs, Belgium	Senior user researcher	8 years	~ 13	2017-03-02	50 minutes
IB2	Imec.livinglabs, Belgium	Panel manager	2 years	~ 5	2017-03-15	50 minutes
IB3	Imec.livinglabs, Belgium	User specialist	2 years	~ 6	2017-03-14	73 minutes
IB4	Imec.livinglabs, Belgium	Senior panel manager	10 years	~ 15	2017-03-15	90 minutes
IB5	Imec.livinglabs, Belgium	User researcher	5 years	~ 6	2017-03-02	75 minutes
IB6	Imec.livinglabs, Belgium	Senior panel manager	2 years	~ 4	2017-03-15	80 minutes
IB7	Imec.livinglabs, Belgium	Senior user researcher	4 years	~ 5	2017-03-01	77 minutes
IB8	Imec.livinglabs, Belgium	User specialist	4 years	~ 5	2017-03-24	57 minutes

Table 1. Information about the interviewees and the interviews.

4 Results

In this section, based on our interviews, we present the results of our study regarding the consequences of drop-out in Living Lab field tests and some recommendations that would facilitate prolonged user engagement throughout Living Lab field test (including some ethical considerations). Accordingly, in each of these two themes (i.e., drop-out consequences and recommendations), we have applied three levels of analysis, namely, macro level (from the research viewpoint), meso level (from the Living Lab viewpoint) and micro level (from the field test and innovation viewpoint) as presented by Schuurman (2015) and outlined in the theoretical background section.

4.1 The Consequences of Drop-out

Regarding the consequences of drop-out, although it might seem obvious to say that drop-out has negative impact on the field test results, we were interested in knowing what were the consequences that those experts have faced in their real experience. The results of our interviews revealed that drop-out in Living Lab field tests might have some strong implications and consequences on the whole field test process both for the project as well as for the Living Lab as a collaborative environment. These consequences include but are not limited to extra time, cost and effort for the field test organizers, reliability of the field test results from the viewpoint of both research and project, losing participants for future Living Lab activities, and difficulties to re-establish mutual trust with those participants.

On the macro level, as mentioned by the interviewees, drop-out might influence the reliability of the research results. It can also affect the way of analysing field test results in some cases. On the meso level, as individual users are one of the most important elements of all Living Lab activities, many Living Lab organizations usually have a number of registered users and a trustful relationship between the users and developers has already been established and it is important for the Living Lab organizers to not to lose their users. When it comes to the micro level, the field test organizers might have to restart the whole test due to high number of drop-outs. Also the innovation will not be reliable because people might not use it due to some reasons that they have dropped out of the field test. Therefore, the field test cannot be considered as a successful field test. Table 2 shows some example quotes taken from the interviews in relation to drop-out consequences and implications.

Analysis level	Verbatim examples	Interviewee
Micro	*Sometimes we had to restart the whole test due to high number of drop-outs. Then it becomes expensive and time consuming.*	BS1
Macro	*Research-wise, drop-out might cause that the results will be more insignificant and unreliable which is directly related to user drop-out.*	BS3
Micro	*The main possible consequences of user drop-out is that when you develop an innovation, and don't test it in real context by enough test users, your innovation will be not reliable because people might not use it due to some reasons that they dropped out of the field test. Then we can really call that test as successful field test?*	BS6
Macro / meso	*But project-wise, when I would have had many drop-outs, I have no way other than analysing the results more qualitatively, although the intended approach for that study was quantitative*	BS3
Meso	*As a panel manager, it could be that those people will unsubscribe from our panel. What I try to do, is to ask them why they dropped out.*	IB5
Macro / micro	*And sometimes we can't use the results because we have too much drop-outs. It is very bad for the research results and also very bad for the evaluation if for example we aiming for 50 but we have only 15 answers.*	BS1
Micro	*Sometimes you cannot trust the results because you have got too few answers to the evaluations that you should do.*	BS1
Meso	*…But if you have a group of users that dropped out one or two times, you will lose them for other future Living Lab activities and maybe forever.*	BS5

Table 2. Some example quotes taken from the interviews in relation to drop-out consequences and implications.

4.2 Recommendations and Ethical Considerations

In this study, we were also interested in hearing the recommendations and suggestions of the experts in Living Lab field tests on how to keep participants motivated and how to reduce the likelihood of drop-out in Living Lab field tests. Since our interviewees have been involved in many different Living Lab field tests with various context, culture and duration, their recommendations would be highly valuable for researchers and practitioners in the field.

On the macro level, ethical issues became more apparent especially in response to the question of *"have you ever tried to re-motivate your participants in order to re-engage them in the field test?"* The results of study showed that, ethical considerations might be related to voluntariness of their 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. Moreover, an important ethical consideration was about the participants' rights and the way that their data and information will be used which is in line with Ley et al.'s (2015) argument that the participants are happy to participate as long as they perceived some benefits in return. As Mensink et al., (2010, p.73) argue: "*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*".

On the meso level, a clear and on time communication and interaction with the test participants and giving the participants this feeling that their contribution is important were more highlighted in the interviews. Also, managing participants' expectation by telling them that it is a prototype and it might not work properly is of vital importance. Therefore, the Living Lab will not lose their users for other future Living Lab activities.

When it comes to micro level, it is very beneficial and useful to look at the past and plan for the future field tests. By doing so, the organizers can estimate the drop-out rate for the field tests that have similar characteristics. Monetary incentive was another factor that was recommended by the interviewees. The interview results showed us that the field test organizers must be careful about the type, amount and time of incentivization. This implies that the incentivizing also depends on the type of field test and in some cases the participants might be interested on the innovation itself more that the incentive. Also cultural factors can affect the amount and type of the provided incentives.

Some recommendations can impact not only at the meso level but also at the micro level when a Living Lab field test is being conducted. For example, some of the interviewees recommended that it is very beneficial and useful to look at the past and plan for the future field tests. By doing so, the organizers can estimate the drop-out rate for the field tests that have similar characteristics and recruit more participants than needed. Another angle to look at drop-out in Living Lab field tests is timing of the activity. We got recommendations regarding both duration of the field test and flexibility of timing. They suggested the Living Lab organizers to have as flexible timing as possible and a shorter field test might be more successful.

One recommendation that reflects on all levels of analysis including macro, meso and micro level was to spend sufficient time to investigate the innovation's functionality before conducting the field test in large scale. This approach was highlighted by six researchers in both Botnia and imec.livinglabs. Among various recommendations and suggestions that we received, paying enough attention to innovation to see if it is understandable for the participants or not, providing a clear and step-by-step guideline on how to fulfil the tasks, a clear and easy to access contact person, and taking care of participants' privacy and security of their information were also highlighted by the interviewees. Table 3 shows some example quotes taken from the interviews in relation to recommendations and ethical considerations.

Analysis level	Verbatim examples	Interviewee
Macro micro / meso	*A pre-test with a number of people from which you expect they would love the innovation, so that you can detect some problems in that group […] this is the way that I usually do in order to not to face high drop-outs in my field test*	IB3
Macro micro / meso	*Try to spend some time yourself on testing the platform in different kind of ways, if you don't notice a problem, try to test is with a volunteer and if there are no problems then, I would test it small scale with friendly users. And make sure you know in advance what you want to know, so that all the interventions are ready.*	IB4
Meso	*A clear and on time communication. That is my first and most important recommendation.*	IB3
Micro / meso	*In the beginning, I would say, the collaboration with the users is the most important factors on keeping them engaged in the field test. Also, it is the organizers obligation to make the users aware of the importance of their contribution. We should also make the testers feel that there is a channel between them and the Living Lab team.*	BS5
Macro / meso /	*Since I always expect to have user drop-out, I have been trying to recruit more users than needed. For instance if I need 50 results, I recruit 100 users […] It is important to compare your current field tests with previous tests so you are able to estimate drop-outs*	BS3
Meso	*…also we should tell them that their contribution is very important for us*	BS6
Meso / micro	*…I really tried to show them that your participation in the test will impact the final service*	BS2
Meso / micro	*Expectation management is crucial, you have to set the right expectations.*	IB7
Meso / micro	*Expectation management is the most important factor, that you lose the possible drop-outs before the tasks actually begins*	IB2
Micro	*Always tell them that it is a prototype and it might not work properly*	BS6
Meso / micro	*It all has to do with expectation management, making clear in advance what might happen during the test and what they could expect.*	IB7
Micro	*Monetary incentives could be also a trigger to participate in the field test. But we need to be careful about what type of incentive should we give them. Some incentives are for entering and some other are for staying engaged in the field test.*	IB1
Micro	*The culture is also very important. You should choose the incentive based on the place that the test users are involved and see what kind of setting is the field test located?*	BS6
Micro	*My feeling is that if you should have monetary incentive or a competition that you can win something. This triggers users to participate and they try to not drop-out until end.*	BS5
Micro	*Some projects are with an incentive, some not. The incentive is not always as important, if the innovation itself is very useful, the [monetary] incentive is less important. So the subject of the field test is important.*	BS6
Micro	*We did not give them any money or other financial compensation. But they were really interested about the innovation and the results. They see benefits from their contribution for themselves as well as for the society. That's why the monetary compensation was not important for them.*	BS6
Macro / meso /	*We always recruit more than we need since we expect user drop-out in all field tests.*	BS3
Meso / micro	*Try to minimize the time and effort. The shorter the test, the less drop-outs, so maybe you can split the field test in little test phases.*	IB2
Meso / micro	*I was very flexible with the timing and if it was possible, [I] asked them about their preferred time to participate.*	BS2

Meso / micro	*The duration of the field test, don't let it take too long, the shorter the better, otherwise, it becomes too intensive for the user.*	IB7
Meso / micro	*According to my experiences, the longer the test takes, the more people drop-out*	IB5
Macro / micro	*Sometimes we try to re-motivate them, especially with the active participants, we go in dialogue with them. But we do not really do this much because it is contradictory to what we said before. If you really start convincing people to keep on testing, it might raise some ethical questions on the one hand and on the other hand, you will influence the results of the test.*	IB5
Macro / micro	*I tried sometimes just by sending them reminders. But the point is that we cannot force them to continue. As we promised them in the beginning, they are allowed to leave the test whenever they want*	BS2
Macro	*…and also, we should tell them how their data and information will be managed and how their contribution will be used.*	BS6
Macro	*I think it is necessary to have an informed consent and through it, we should give them necessary information about their rights and their costs and benefits.*	BS6
Meso / micro	*Drop-out causes disappointment, but also a sense of reality for the client/instigator. This is of course followed by a sort of process: what was the reason for the drop-out? Was it because of the organisation of the field test or the innovation itself?*	IB3
Macro / meso	*I think in order to reduce the drop-out rate, you should not only pay attention to users' motivation, but also consider the motivation of responsible persons or researchers. If they have enough motivation and resources, they will better manage the situation of field test.*	BS2

Table 3. Some example quotes taken from the interviews in relation to the recommendations and ethical considerations.

5 Discussion and Conclusion

Considering Living Labs as a socio-technical system, drop-out reasons might be related to all aspects of the Living Lab setting, namely, social aspects, technical aspects and socio-technical aspects. Technical aspects (i.e., technological problems, perceived ease of use and perceived usefulness) are the group of items that are associated with technology in which the innovation plays the central role in this theme. When it comes to social aspects, environmental context such as participants' everyday context and their resources are more influential on their drop-out behavior. Accordingly, social aspects are more related to the participants and their personal context. Regarding the socio-technical aspects, the way of organizing the research, communication and interaction between different stakeholders, designing the tasks and timing are influential on drop-out behavior.

When it comes to the consequences of drop-out, this study highlighted that drop-out in Living Lab field tests might have some strong implications and consequences on the whole field test process both for the project as well as for the Living Lab as a collaborative innovation network. These consequences include but are not limited to extra time, cost and effort for the field test organizers, reliability of the field test results from the viewpoint of both research and project, losing participants for future Living Lab activities, and difficulties to re-establish mutual trust with those participants. The abovementioned consequences of drop-out are mainly focused on the amount of dropped out participants, which relates to a reduction of the success and reliability of the field test.

According to the drop-out definition, dropped out participants are those who signed up to participate in the Living Lab field test, but does not complete all the assigned tasks within the specified deadline (Habibipour et al., 2017). Although the drop-out rate can be high based on this definition, we believe that valuable results can be generated if we can briefly receive feedback from the dropped out participants to understand why they stopped testing. Then, the drop-outs can become a prediction of why people would stop using the innovation in the actual launch, if the drop-out is related to the innovation instead of related to the process or the participants. This is also pointed out during the interviews, where one interviewee stated that:

"Drop-out causes disappointment, but also a sense of reality for the client/instigator. This is of course followed by a sort of process: what was the reason for the drop-out? Was it because of the organisation of the field test or the innovation itself?"

In this study, we gathered some recommendations to understand what the organizers of a Living Lab field test should do and how they can act in order to reduce the likelihood of drop-out in Living Lab field tests. Spending enough time to investigate the innovation's functionality before conducting the actual field test, a clear and on time communication and interaction with the test participants, giving them this feeling that their contribution is important, managing participants' expectation, flexible and appropriate timing of the field test, avoiding to prolong the field test, and considering an appropriate financial reward for the participants were the main suggestions that we received from our interviewees. Hereby we should take into account that the act of trying to reduce drop-out is mostly focused on the process and participant-related factors for drop-out. When it comes to innovation-related factors, only recommendations to reduce technological problems were mentioned. One plausible explanation is that reducing drop-out by responding to the ease of use and usefulness of the innovation could distort the results of the field test. Of course, this depends on the goal of the field test.

An important lesson learned from this study was that the organizers of the field test must pay enough attention to the users' motivation and be careful about the type of incentive they will choose for the participants. Despite this fact that intrinsic motivations have been considered as more beneficial and influential (particularly in voluntary contribution) compared to extrinsic motivations (Ståhlbröst and Bergvall-Kåreborn, 2011, 2013; Zheng, Li, and Hou, 2011), our interviewees emphasized the need to consider both intrinsic and extrinsic motivators in Living Lab field tests based on the field test type. Accordingly, by considering this fact that extrinsic and intrinsic motivational factors can influence each other or even may have some conflicts (Hossain, 2012), we argue that further research is needed to understand how best to mix intrinsic and extrinsic motivators and how that varies with the type, place, culture and duration of Living Lab field tests.

Regarding the motivational factors, another interesting new clue for further research was related to the motivation of the field test organizers and drop-out in Living Lab field tests. As an interviewee stressed this point:

"I think in order to reduce the drop-out rate, you should not only pay attention to users' motivation, but also consider the motivation of responsible persons or researchers. If they have enough motivation and resources, they will better manage the situation of field test."

In respect to ethical considerations, as the results showed us, the first and foremost ethical consideration in user engagement in Living Lab activities is whether their engagement is totally voluntary or not. As Ley et al. (2015) argue, in many cases users feel obliged to participate in the Living Lab activities such as diary studies, testing a prototype or to be interviewed since they received a technology in return of their participation. On the other hand, when it comes to group activities, 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, and Pietilä, 2004). This pressure to participate can make it difficult for the voluntary contributors to withdraw from the activity or refuse to participate (Magnusson and Hanson 2003).

Overlooking the users' interest in Living Lab activities is also an important ethical consideration. As mentioned by Mulder and Stappers (2009), "*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*" (p. 2). It is more important to consider users as a valuable source of knowledge and idea, not to see them as "ginny pigs" for experiment (Eriksson, Niitamo, and Kulkki, 2005). A lot of Living Lab field tests tend to overlook the participants' needs and interests since the field tests are mostly technology-driven and the users are involved with an innovation which is to be designed, tested or evaluated.

Unwitting participation was another ethical consideration in Living Lab activities. As mentioned, Living Labs are environments that individual users are involved in the process of system development in their own real-life environment. The environment could be their home, their workplace, their car or in public spaces that they spend their time. There are many kinds of Living Lab field tests in which users are not able to withdraw from being involved in that activity. Such an example for these activities is when monitoring infrastructures are established in public places such as an airport, a train station or a city hall. In this case it might be impossible for the targeted people to opt out of the activity however they must be able to do so (Mensink et al., 2010). However, according to the definition of drop-out, we must reflect if those drop-outs can really be considered as dropped out, seen from the point of view that these participants have not signed up to participate.

Another angle to look at unwitting participation refers to the informed consent when the research is focused on participation of a whole family members such as testing an innovation related to energy consumption research (Krogstie et al., 2013). In this case, the whole family are supposed to be involved at their homes. As Hindus (1999, p. 202) states: "*informed consent is trickier for homes, because of the presence of children and the centrality of children to home life*". Within open innovation activities in which participation is voluntary, it is very important to spend enough time to prepare the informed consent. As Neuman (2002) argues: "*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*" (p. 135). To avoid overwhelming users, Living Lab researchers should explain and discuss the content of informed consent with the users as much as possible. The information in the informed consent must be realistic enough and provide the participants not only the purpose and benefits of their engagement, but also about the potential risks and costs of their involvement (Mensink et al., 2010). This is because sometimes the informed consent does not explain the real issues. As recommended by Vines et al., (2013), these ethical concerns confirm that further research is needed to acquire more understanding about the procedures and ethical standpoints of unwitting participation when it comes to participatory research.

All studies have their limitations. One limitation was that the study used field tests in two Living Labs (namely, Botnia and imec.livinglabs). Therefore, we might not be aware and well-informed about the way that other Living Labs set-up, organize, manage and conduct their field tests and consequently, the drop-out consequences could be different in those field tests due to many reasons such as cultural factors. Moreover, drop-out behavior might be associated with other influential factors such as degree of openness, number of participants, level of engagement, motivation type, activity type and longevity of the field test. Therefore, these findings are tentative and might not be possible to generalize in different situations. Moreover, although the initial list of drop-out factors were extracted from the dropped out participants viewpoint in the previous literature, the current results are seen only from Living Lab experts' point of view and are derived based on their opinions. We strongly believe that future iterations of this work should triangulate our data by including dropped out participants' perspective in a more longitudinal study by utilizing different data collection methods and techniques (e.g., interviewing the dropped out users and even those who have completed the test). Furthermore, the limited number of interviews (fourteen interviewees) can be considered as another limitation of this study and further interviews would have made the information even richer.

This study contributed to the existing literature by gaining insight into the possible consequences of drop-out in Living Lab field tests, providing some recommendations that would facilitate prolonged user engagement, and discussing some ethical considerations regarding involving participants within Living Lab field tests. This study also pointed to avenues for future research that creates numerous opportunities for the future research in this area.

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