Drop-out in Living Lab Field Tests: A Contribution to the Definition and the Taxonomy

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Abstract: Studies on living labs show that the users’ motivation to participate in a field test is higher at the beginning of the project than during the rest of the test, and that users tend to drop-out before completing the assigned tasks. However, the literature still lacks theories describing the phenomenon of drop-out within the area of living lab field tests. As the first step of developing a theoretical discourse, the aim of this study is to present an empirically derived taxonomy for the various influential factors on drop-out behavior and to provide a definition for drop-out in living lab field tests. To achieve this goal, we first extracted factors influencing drop-out in the field test by conducting a short literature review on the topic, and then triangulated the factors across 14 semi-structured interviews with experts in living lab field tests. Our findings show that identified reasons for drop-out can be grouped in three categories: innovation-related, research-related and participant-related. Each category in turn, consists of three subcategories with a total of 45 items for drop-out in living lab field tests. In this study we also explore different types of drop-out and propose a definition for drop-out in living lab field tests.

Keywords: User engagement, Drop-out, Living Lab, Field test, Taxonomy, User motivation.

Introduction

Individual users are considered as one of the most valuable external sources of knowledge and a key factor for the success of open innovation (Jespersen, 2010). One of the more recent approaches of managing open innovation processes are living labs, where individual users are involved to co-create, test and evaluate an innovation in open, collaborative, multi-contextual and real-world settings (Bergvall-Kåreborn, Holst, & 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). In a living lab setting, a field test is a user study in which the interaction of test users with an innovation in the context of use is tested and evaluated (Georges, Schuurman, & Vervoort, 2016).

Involving individual users in the process of 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 & Zowghi, 2015; Leonardi et al., 2014; Lin & Shao, 2000). However, when it comes to testing an 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 (Ley et al., 2015; Ogonowski, Ley, Hess, Wan, & Wulf, 2013; Ståhlbröst & Bergvall-Kåreborn, 2013). Consequently, the users tend to drop-out of field test 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 before completing the assigned tasks (O'Brien & Toms, 2008) and is occurring in all phases of the innovation process, from contextualization to test and evaluation (Habibipour, Bergvall-Kåreborn, & Ståhlbröst, 2016).

Keeping users enthusiastically motivated during the whole process of open innovation is of crucial importance and a number of previous studies have acknowledged the importance of sustainable user engagement (Hess & Ogonowski, 2010; Leonardi et al., 2014; Ley et al., 2015). There are a number of reasons for this concern as those users already have a relatively profound understanding and knowledge about the project (Hess & Ogonowski, 2010), they are able to provide deeper and more detailed feedback (Ley et al., 2015; Visser & 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; Padyab, 2014). 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 & Fægri, 2006; Ley et al., 2015). Kobren et al. (2015) assert that a participant after dropping out will not have any additional value for the project or activity.

As far as we are aware, the literature still lacks theories describing the phenomenon of drop-out within the area of living lab field tests. To develop a theoretical discourse about drop-out in field tests, there is a need to define, categorize and organize possible influential factors on drop-out behavior. Such a taxonomy can form the basis for a theoretical framework in the area of this study. Accordingly, the aims of current study are: (a) to provide an empirically grounded definition for drop-out in living lab field tests, (b) to understand the different types of drop-out, and (c) to develop an empirically derived, comprehensive taxonomy for the various influential factors on drop-out behavior in a living lab setting.

To achieve this goal, we first conducted a short literature review and then, interviewed 14 experts in the area of field testing in a living lab setting. The next section outlines the methodology and research process for derivation of the taxonomy followed by the section that provides the results of the short literature review. After that, we present different types of drop-out and a definition for drop-out in living lab field tests. Finally, the developed taxonomy for drop-out in living lab field tests is presented and the paper ends with some concluding remarks.

**Methodology**

As mentioned, the aim of current study is to provide a definition for drop-out, to understand different types of drop-out and to develop an empirically derived taxonomy for the various factors on drop-out behavior in a living lab field test setting. In order to better understand drop-out behavior of field test participants, a detailed and systematic study needs to be conducted in their natural setting within a qualitative approach (Kaplan & Maxwell, 2005). Since the qualitative research is generally inductive in nature, qualitative researchers might start gathering data without constraining themselves to an explicit theoretical framework which is called “grounded theory” (Glaser & Strauss, 2009; Strauss & Corbin, 1998). The use of grounded theory is justifiable in this study since, the literature still lacks theories and taxonomies describing the phenomenon of drop-out in living lab field tests. In contrast with a typology in which the categories are derived based on a pre-established theoretical framework, the taxonomies are emerged empirically within an inductive approach and are developed based on observed variables (Sokal & Sneath, 1963).
In order to develop a taxonomy for drop-out, we started gathering information about drop-out reasons within various qualitative data collection methods. According to Kaplan and Maxwell (2005), qualitative data may be gathered using three main sources namely, 1) observation; 2) semi-structured interviews; and 3) documents and texts. Accordingly, in this study qualitative data were collected in two major steps. First, we extracted possible drop-out reasons in living lab field tests by reviewing previous literature and then, these findings were triangulated by interviewing experts in living lab field tests to increase and ensure the validity and trustworthiness of the collected data to build a taxonomy for drop-out. Figure 1 shows the research process for this study.

In the first major step, we explored documented reasons for drop-out in field tests. As recommended by Strauss and Corbin (1998), within grounded theory research which still lacks explicit boundaries between the context and phenomenon, reviewing previous literature can be used as the point of departure for the research. Accordingly, this phase of data collection was done according to the results of a literature review on the topic (Habibipour et al., 2016). By doing so, we extracted 29 items. In addition, we identified other possible influential factors on drop-out from four different field tests in both imec
living labs (three field tests) (Georges et al., 2016) and Botnia living lab (one field test)\(^1\) (Habibipour & Bergvall-Kåreborn, 2016). In these field tests, the data was collected by conducting an open-ended questionnaire as well as direct observation of drop-out behavior. This also resulted in 42 items. After eliminating redundant or similar items, we ended up with 53 items.

In order to promote stronger interaction between research and practice and obtain more reliable knowledge, it is recommended by social scientists that different perspectives should be included in the study (Kaplan & Maxwell, 2005). This approach is in line with Van de Ven’s (2007) recommendation to conduct social research which is labeled 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” (Van de Ven, 2007, p. 9). Thus, in the second round of data collection, we conducted 14 semi-structured, open-ended interviews with experts in living lab field tests. 8 out of 14 interviewees were user researchers or panel managers from imec living labs in Belgium and 6 of them were living lab researchers from Botnia living lab in Sweden. The aim of these interviews was to triangulate the findings of the first data collection wave with the researchers that enables us to find an initial structure for the proposed taxonomy. In this study, we used both data and method triangulation to increase the reliability as well as the validity of the results and greater support to the conclusions (Benbasat, Goldstein, & Mead, 1987; Flick, 2009).

The topic guide of the interview consists of two major parts. First, the interviewees were asked open questions about living lab field tests, drop-out and components of drop-out (e.g. definition, types of drop-out, main drop-out reasons and when they consider a participant as drop-out). In the second part, we used the results of our short literature review as input for developing the interview protocol and thus, the interviewees were given 53 cards each one showing an identified factor. We asked the interviewees to put these cards in three main categories of: (1) not influential at all, (2) somewhat influential, and (3) extremely influential on drop-out in the living lab field tests they were involved in. They also were provided by some empty cards in case they wanted to add other items which were not presented in the main 53 cards. They then were asked to group extremely influential items into coherent groups with a thematic relation. This helps us to identify the main categories for drop-out and enables us to develop our taxonomy.

When it comes to analysis of the data, qualitative coding was used because it is the most flexible method of qualitative data analysis (Flick, 2009) and allows researchers to build a theory through an iterative process of data collection as well as the data analysis (Kaplan & Maxwell, 2005). In this regard, developing a taxonomy is the first step to propose a way to empirically build a theoretical foundation based on the observed factors (Stewart, 2008). This approach facilitates insight, comparison, and the development of the theory (Kaplan & Maxwell, 2005) and enables us to identify key concepts in order to develop an initial structure for the taxonomy for drop-out in living lab field tests. In order to properly analyze data and gain thorough insight, Microsoft Excel 2016 as a spreadsheet tool for coding and combining the collected information was used.

### Literature Review Results

Previous studies show that, finding motivated and engaged users is not an easy task (Georges et al. 2016; Kaasinen, Koskela-Huotari, Ikonen, & Niemeléi, 2013) as they may tend to drop-out before completing

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\(^1\) For a more detailed description of each field test such as the number of participants, field test duration and study set up, see Georges et al. (2016) and Habibipour & Bergvall-Kåreborn (2016).
the project or activity. However, to the best of our knowledge, there are few studies addressing drop-out reasons in the living lab field test.

Habibipour et al. (2016) carried out a comprehensive literature review to identify documented reasons for drop-out in the information systems development process. The authors in this study identified some influential factors on drop-out behavior and classified them in three main areas of consideration: technical aspects, social aspects 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 the variety of reasons for drop-out (Habibipour & 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 wrong 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.

In total, we extracted 29 items from the first article (Habibipour et al., 2016), 27 items from the second article (Georges et al., 2016) and 15 items from the third article (Habibipour & Bergvall-Kåreborn, 2016). By removing redundant items, we ended up with 53 influential factors on drop-out behavior. As it can be seen, none of the above mentioned studies have ended up with the same classification or category of reasons for drop-out nor presented a clear definition for drop-out in living lab field tests. In this study, we argue for the need of a clear definition as well as a taxonomy for possible drop-out reasons. Taxonomies are useful for research purposes to leverage and articulate knowledge and are fundamental to organizing knowledge and information in order to refine information through standardized and consistent procedures (Stewart, 2008).

**Definition and Types of Drop-out**

The results of our study showed that drop-out occurs in different steps of a field test and might be associated with various reasons. By analyzing the interviewees’ responses to open-ended questions of “when do you consider a participant as dropped out?” and “what is drop-out in living lab field tests according to you?”; we ended up with different types of drop-out in living lab field tests. The **participant drop-out** where the participants only participate in the startup of the field test but they have
not started to use that innovation. As one of the interviewees stated: “Drop-out is when they have started the test period and they are not fulfilling the assignments and complete the tasks. First of all we need to think of the term 'user'. If they drop-out before they actually used anything, can we call them user drop-out or should we call them participants? If they are only participating in the startup but they have not started to use that innovation we can’t really call them user. If they have downloaded or installed or used the innovation or technology, then they are users.”

**Innovation-related drop-out** occurs when participants stop using the innovation because of motivational or technical reasons related to the innovation. Regarding the innovation-related drop-out, the interviewees made comments such as: “...people have to install something and they don’t succeed because they don’t understand it or the innovation is not what they expected or wanted” Or: “During the field test, the longer the field test, the bigger the drop-out. I’ve seen it, why should I still use it?”

**Research-related drop-out** occurs when the participants stop participating in the research component of the field test, you don’t get feedback anymore from them. As an interviewee stated: “We as researchers must be particularly afraid of methodological drop-out, because then we cannot get feedback from test-users”. Or as another interviewee stated: “People that do not fulfill the final task (mostly a questionnaire) are also considered as drop-out for me.”

Our finding also supports O’Brien & Toms’s (2008) argument that user disengagement might be due to internal decision of the participant to stop the activity or external environmental factors that caused them to terminate their engagement before completing the assigned tasks. Accordingly, the drop-out decision can be made conscious or unconscious by the participants but is characterized by the fact that they don’t notify this to the field test organizers. For instance, an interviewee made a distinction between dropped out users and a defector which is someone who notifies to stop but still gives feedback: “If you stop testing and you keep on filling in the surveys (participating in research), you are not a dropped out user. You need to make a distinction between stop testing the application and stop filling in the surveys...”

What is common in all mentioned types of drop-out is that the participants showed their interest to participate in the field test but they stopped performing the tasks before the field test has ended. Thus, we propose this definition for drop-out in living lab field test as:

“A drop-out during a living lab field test is when someone who signed up to participate in the field test, does not complete all the assigned tasks within the specified deadline”

Within this definition three elements are of importance: (1) the dropped out participant signed up to participate, this implies that the participant must be aware of what is expected of him/her. Next to this, (2) the dropped out participant didn’t complete all the assigned tasks. Depending on the type of field test, this could be the act of using/testing the innovation, but could also refer to participating in research steps (e.g. questionnaires, interviews, diary studies...). This difference was already made by Eysenbach (2005) in his law of attrition (drop-out attrition and non-usage attrition). Finally, (3) the drop-out participant didn’t complete the tasks that were assigned to him/her within the specified deadline that was agreed upon.

**Towards a Taxonomy for Drop-Out in Living Lab Field Tests**

As mentioned in the methodology section, the developed taxonomy is grounded on the results of a literature review article (Habibipour et al., 2016) as well as the results of four living lab field tests (Georges et al., 2016; Habibipour & Bergvall-Kåreborn, 2016). The findings of the previous steps were triangulated across 14 semi-structured interviews. This triangulation of the data strengthens the validity of the presented taxonomy and makes our results stronger and more reliable (Benbasat et al., 1987). The interviewees were asked to group the items that are extremely influential on drop-out into coherent groups under headings with a thematic relation. Our goal was to identify the most frequent suggested categories by the interviewees. Table 1 shows the categories of items that were initially suggested by the interviewees. B1 to B8 refers to the interviewees in imec living labs in Belgium and S1 to S6 refers to the interviewees in Botnia living lab in Sweden. In some cases, an item can belong to different categories because the same item was interpreted differently by the interviewees. For example, two interviewees mentioned privacy and security concerns as “personal context” while six of them
considered it under the category of “participants’ attitude”. Thus, we decided to put the privacy and security concerns under the “participants’ attitude” category.

An important outcomes of this study was to refine the initial list of items which was extracted from the previous literature. During the interviews, we asked the interviewees to express their feelings about each item if they have some comments or extra explanation about that item. By doing so, we eliminated some items that were similar and combined the items that were very closely related. In this study, we were also interested in discovering other factors on drop-out behavior that we were not aware of. Some of the interviewees also added additional items to our original list. As a result, we ended up with a revised list of items which was used to develop the taxonomy. The modified list of items is shown in Appendix A.

| Category                          | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | S1 | S2 | S3 | S4 | S5 | S6 | Number of hits |
|-----------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----------------|
| Technological issues              | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 12             |
| Participants' resource limitation | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 10             |
| Personal reasons / problems       | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 9              |
| Communication/interaction         | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 9              |
| Innovation related               | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 9              |
| Planning/Test design              | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 9              |
| Timing                            | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 7              |
| Privacy and security              | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 6              |
| Personality / participants' attitude | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 6              |
| Forgetting                        | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 3              |
| Complexity                        | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 3              |
| Motivational factors / benefit    | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | *  | 2              |

Table 1. Summary of the suggested categories by the 14 interviewees

According to the results of the 14 interviews and based on the number of overlaps in the categories, nine categories seemed to us the most meaningful way of organizing the factors influencing drop-out in living lab field tests. The identified categories could be grouped under three main headings: innovation-related categories, research-related categories and participant-related categories. In the following, we discuss each of these headings in more detail.

Innovation-related drop-out

The categories under this heading are the ones that are directly related to the innovation itself. Technological problems, perceived ease of use and perceived usefulness were the categories that were suggested by the interviewees most frequently. Hereby we have to note that, the interviewees are experts in their domain, therefore we suppose that the concepts of ‘perceived ease of use’ and ‘perceived usefulness’ are based on work of Davis (1986) and Venkatesh et al. (2000) on the technology acceptance model.

Technological problems: As the results of the interviews revealed to us, technological problems are among the most important innovation-related factors which play a role in drop-out behavior. These group of items might be associated with the trouble of installing the innovation, flexibility or compatibility of infrastructure as well as stability and maturity of the (prototype) innovation.

Perceived usefulness: When it comes to perceived usefulness, users’ need becomes more highlighted. When the innovation does not meet the user’s needs, it might be difficult to maintain the same level of engagement throughout the lifetime of a field test. On the other hand, a participant who is voluntarily contributing in a field test, must be able to see the potential benefits of testing an innovation in his/her everyday life.

Perceived ease of use: Regarding the perceived ease of use, complexity of the innovation might negatively influence on participants’ motivation. When the innovation is too complex to use or is not easy to understand, it would increase the possibility of participants’ confusion and their discouragement.
Moreover, when the innovation is not mature enough, it is difficult to keep the participants enthusiastically engaged in the field test.

**Research-related drop-out**

There were some identified categories which related to the research setting. The categories under this heading were associated with task design, interaction with the participants and timing of the field test.

**Task design:** The results showed that there are various factors related to the design of the field test. For instance, when the tasks during the field test were not fun to accomplish, participants tend to drop-out before completing the test. The interviewees also considered the items such as long gap between the field test’s steps or a lengthy field test as influential factors that might be associated with the task design in the field test.

**Interaction:** Interaction and communication with the participants was considered as one of the most important groups of items that are influential on participant’s decision to drop-out. Unclear guidelines on how to do the tasks, lack of an appropriate technical support and insufficient triggers to involve participants are some examples of the items in this group.

**Timing:** When it comes to timing, inappropriate timing of the field test (e.g., summer holiday) and too strict and inflexible deadline are the most influential factors on drop-out behavior. When the participants are not able to participate in field test at their own pace, they would prefer to not test the innovation any longer.

**Participant-related drop-out**

Some of the suggested categories were directly related to the individuals. The participants’ attitude or personality, personal context and the participants’ resource can be classified under the participant-related heading.

**Participants’ attitude:** There are a number of items that can be subsumed under the category of participants’ attitude or personality. For example, when the participants forget to participate, when the innovation does not meet their expectation, when they don’t want to install something new on their device, when they don’t like the concept or idea, and when they have concerns about their privacy or the security of their information.

**Personal context:** Since in a living lab approach, the users usually are engaged to test in their real-life setting, their personal life problems can negatively influence their motivation and in conclusion, they might drop-out of the field test.

**Participants’ resource:** Limitation of participants’ resource can also be another category of items that are influential on drop-out. They might either have not had enough time to be involved in the field test, or need to consume their own mobile battery or internet data quota.

The developed taxonomy based on the resulted headings and categories is shown in Figure 2. To see the items under each of the headings and subcategories see Appendix A.
Discussion and conclusion

In this study, we developed an empirically derived, comprehensive taxonomy for the various influential factors on drop-out behavior in a living lab field test. To develop a theoretical discourse about drop-out in field tests, there is a need to define, categorize and organize possible influential factors on drop-out behavior. Accordingly, we first identified factors influencing drop-out in the field test by conducting a short literature review on the topic and then, interviewed 14 experts who are experienced in the area of field testing in a living lab setting.

According to the proposed taxonomy, the drop-out reasons were mainly related to the innovation, research setting and the participants themselves. Regarding the innovation-related items, technological problems, perceived ease of use and perceived usefulness were the main categories that mentioned by the interviewees. When it comes to research setting, task design, timing as well as interaction and communication with the participants were more highlighted in the results. Regarding the participant-related categories, their personality or attitude, participants' personal context and limitation of their resources were the main category of reasons for drop-out.

In this study, we also identified various types of drop-out in living lab field tests. The drop-out might be occurred in a field test when (a) the participants sign up for a test but they don’t show up or don’t start testing the innovation (participant drop-out); (b) the participants start using the innovation but due to a technological or motivational reason they don’t complete the tasks related to the use of the innovation (innovation-related drop-out); and (c) the participants use the innovation but they don’t give their feedback to the organizers (research-related drop-out). Combining these finding, we introduced our definition for drop-out in living lab field tests.

The presented taxonomy can be put to work in several ways. For instance, we believe that there is a need for practical guidelines that describe what the organizers of a living lab field test should do and how they should act in order to keep participants motivated and reduce the likelihood of drop-out throughout the innovation process. This taxonomy can be used as a framework to develop such practical guidelines for the field test organizers. As another example, this taxonomy might be used as the basis to develop a standard post-test survey to identify the reasons for drop-out in various field tests in different living labs.

Our study was not free from limitations. One limitation was that the drop-out reasons were extracted based on the 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 reasons could be different in those field tests due to many reasons such as cultural factors. Furthermore, drop-out behavior might be associated with other influential factors such as degree of openness, number of participants, level of user engagement, motivation type, activity type and longevity of the field test. As an example, fixed and flexible deadlines to fulfill the assigned tasks might have resulted to different drop-out rate in a living lab field test (Habibipour et al., 2017).

This study also opens up several avenues for future research. As O’Brien and Toms (2008) have introduced re-engagement as one of the core concepts of their user engagement process model, an interesting topic for further research would be to clarify how and why user motivation for engaging and staying engaged in a living lab field test differ. Moreover, it is of importance to study how the organizers of a field test can re-motivate the dropped out participants in order to re-engage them in that field test and what are the benefits of doing so. Our hope is that the presented definition and the taxonomy can be used as a starting point for a theoretical framework in the area of this study.

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## Appendix A

<table>
<thead>
<tr>
<th>Technological problems</th>
<th>Perceived usefulness</th>
<th>Perceived ease of use</th>
<th>Task design</th>
<th>Interaction</th>
<th>Timing</th>
<th>Participants' attitude</th>
<th>Personal context</th>
<th>Participants' resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>I had trouble installing the innovation</td>
<td>There were no benefits for me in the innovation</td>
<td>The innovation was not user friendly</td>
<td>It was a lengthy project</td>
<td>There was no clear guideline on how to do the tasks</td>
<td>Timing of the project was inappropriate</td>
<td>There were no benefits for me in the field test</td>
<td>Personal context made me unable to keep on participating in the test</td>
<td>I had not enough time to be involved in this project</td>
</tr>
<tr>
<td>There were problems with compatibility of the infrastructure</td>
<td>The innovation did not meet my needs</td>
<td>The innovation was not mature</td>
<td>The tasks during the field test were not fun to accomplish</td>
<td>I was not satisfied with the technical support during my involvement period</td>
<td>I was not able to participate in this project at my own pace (e.g. strict deadlines, inflexible)</td>
<td>I forgot to test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The innovation was technologically too complex</td>
<td>I have no faith in the future of this innovation (I wouldn't use it and don't think others would either)</td>
<td>The innovation was not easy to understand</td>
<td>The tasks were not easy to understand</td>
<td>It was unclear what was expected of me during the field test</td>
<td></td>
<td>I did not want to install something new on my device</td>
<td>I had to consume my own resources such as battery</td>
<td></td>
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<tr>
<td>The innovation was not stable</td>
<td>The innovation had too few functions</td>
<td>The innovation did not meet my expectations</td>
<td>I couldn't test where and when I wanted</td>
<td>I lost my involvement over time</td>
<td></td>
<td>The innovation was not reliable</td>
<td></td>
<td>I had to use my own device</td>
</tr>
<tr>
<td>External context made me unable to keep on participating in the test (e.g. not enough content, not enough users)</td>
<td></td>
<td></td>
<td>There were not enough triggers to be involved in the field test</td>
<td></td>
<td></td>
<td>The novelty aspects of the innovation quickly disappeared</td>
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<tr>
<td>The field test organizers did not give me this feeling that my contribution is important</td>
<td></td>
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<td></td>
<td>The innovation did not stimulate my curiosity</td>
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<td>The guidelines and instructions were not easy to find or access</td>
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<td></td>
<td>I had concerns about my privacy and the security of my information</td>
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<tr>
<td>I was not satisfied with the way(s) in which I received feedback from the project</td>
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<td>I didn't like the concept/idea</td>
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<tr>
<td>There was no mutual trust with the organizers of the field test</td>
<td></td>
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<td>There is no/too small incentive / prize to participate</td>
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<tr>
<td>I had not been informed about the project's details before the start of the field test</td>
<td></td>
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<td></td>
<td>I was just interested in what the innovation would be like, but never had the intention to fully participate</td>
<td></td>
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</tbody>
</table>