Co-creation in Living Labs: Exploring the Role of User Characteristics on Innovation Contribution

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Abstract

Since the 1970s, the innovative potential of users has been recognized by von Hippel and his seminal works on the Customer Active Paradigm (CAP) and Lead Users. This fostered further research into the nature of user contribution in NPD and the characteristics of innovative and innovating users. This research stream has been labeled 'user innovation' and looks at the utility gains for end-users when involved in innovation. More recently, open innovation approaches have been looking to integrate the insights and creative potential of users through various methods and tools. One of these approaches gaining ground are the so-called Living Labs, an innovation approach relying on intensive user involvement through co-creation, using real-life settings and a multi-stakeholder approach. Although user involvement is seen as key within these Living Labs, research integrating the insights from user innovation into ways of user selection and user contribution in Living Labs is scarce. Within this paper, we will explore some of the hypotheses from user innovation regarding user characteristics in three concrete Living Lab projects and assess whether these characteristics have an impact on the outcomes and on the user contribution. The results indicate that it is necessary to take

into account domain-related as well as innovation-specific characteristics, otherwise this may lead to one-dimensional user contributions. Moreover, our research suggests that Living Labs are capable to facilitate a diversity of user contributions through a mix of self-selection and purposeful sampling.

Introduction

The fast pace of technological changes, globalization and increased access to knowledge have engaged more people to start innovating themselves. Moreover, companies are increasingly looking for (potential) users to contribute to the production of new products and services (Bogers et al., 2010). In addition, research has indicated that different types of users have different kinds of needs. People generally have a higher willingness to pay for a product or service which perfectly satisfies their personal needs (Franke & Piller, 2004). To develop such customized products or services, it is important to involve users in the innovation process by giving them the possibility to adapt products themselves (Franke & von Hippel, 2003). Therefore, co-creation has become increasingly important within the innovation development processes. The interaction between the firm and the consumer is becoming the locus of value creation and value extraction. As value shifts to experiences, the market is becoming a forum for conversation and interactions between consumers, consumer communities, and firms (Prahalad & Ramaswamy, 2003). Co-creation makes it possible for users to have a lasting impact and contribution on innovation.

User innovation

The foundations of the user innovation paradigm can be traced back to von Hippel's work on innovating users, the so called Lead Users. During his early research on innovation von Hippel noticed that regular market research, used for need detection when innovating within the market pull paradigm, usually fosters general needs that are common in the market place (Lüthje & Herstatt, 2004; von Hippel, 2005; von Hippel, 1986). User knowledge is often bound to past and current experiences, constraining insights into new products by real life experiences. In order to forecast their new needs and potential solutions, the customers will have to integrate the potential product into a use context that does not exist yet (Davis, 1993), which is a mentally challenging task. The familiarity with current products, often inhibits the conception of novel product attributes (von Hippel, 1986). This resulted in a wave of 'incrementalism', or innovations that only contained slight

modifications or adjustments to already existing products or services. Instead of classical market research, he pled for new tools able to generate novel and innovative input and trends, which would lead to radical, breakthrough innovation (von Hippel, 1986). Therefore von Hippel suggested working with so-called Lead Users in the early phases of innovation (Herstatt & von Hippel, 1992; Luthje & Herstatt, 2004). Lead Users display two main characteristics with respect to a novel or enhanced product, process or service: a) Lead Users face needs months or years before they will be general in a marketplace and b) Lead Users expect to benefit significantly by obtaining a solution to these needs. Opposite to the majority of users, whose personal real-world experience sets the limits of their imagination and problem solving abilities, Lead Users do have real-life experience with novel product or process concepts (Lettl, 2004; von Hippel, 1986) which allows them to take the role of a 'need-forecasting laboratory' (Lilien et al., 2002; Lüthje & Herstatt, 2004; von Hippel, 1986).

Lead Users are also seen as sources of innovative solutions (Lilien et al., 2002; von Hippel, 2005). It is also contended that being a Lead User is relative with regards to the trend or innovation domain that is focused upon, meaning that an individual who is a Lead User for one field does not have to be a Lead User in a totally different or even an adjacent field (von Hippel, 1986). In his later work, Lead Users are related to the concept of 'sticky information' which implies that user needs can be latent and thus hard to transfer to the manufacturer (von Hippel, 2005). When a company succeeds in integrating Lead Users into its innovation processes, they can possibly overcome this information stickiness and solve their own functional fixedness. As was demonstrated within Lead User-research, user innovation is quite common in some product domains (e.g. extreme sports, see e.g. Lüthje, 2003), but this is not always the case. In other words, when user innovation is scarce or not easily detectable, Lead Users that have not innovated (yet) should be somehow involved within the innovation process in order to capture their advanced needs.

The two 'extreme' stances regarding this involvement are summarized by Hansson (2006): voice of the customer-methods and Lead User-methods. With the former, the manufacturer identifies

consumer needs and develops solutions, whereas in the latter, the manufacturer works with Lead Users who develop solutions or identify solutions that have already been developed by Lead Users. These stances were also defined by von Hippel as the Manufacturer Active Paradigm versus the Customer Active Paradigm. It was believed that conventional marketing techniques (Voice of the Customer-methods) are appropriate for incremental innovation, but are of limited value in radical innovation projects because of the unknown use context (Lynn et al., 1996, O'Connor, 1998). Piller & Ihl (2009) argued that the Lead User-concept has dominated the perspective of the earlier research on user innovation, and plead for a collaborative mode of user participation, which they call 'design by customers' or open innovation with customers. This can be seen as an intermediate stance, relying on co-creation with the locus of innovation able to shift between both users/customers and manufacturers (table 1). With co-creation the innovation process is no longer seen from a single-inventor perspective or a serial-single-inventor perspective (cumulative innovation), but innovation is considered as the collaborative development by two or more stakeholders. This process involves knowledge inflows and outflows between complementary partners, including horizontal and vertical alliances (Bogers et al., 2010). Beyond creating product innovation, co-creation can also be a way to create value more generally (Prahalad & Ramaswamy, 2003; Vargo & Lusch, 2004). Within this paper, we focus on co-creation with users.

[Insert table 1 about here]

First, the co-creation methodology was regarded as suited only for users with specific Lead User or other characteristics, but recently it was suggested that 'ordinary users' can also contribute to radical innovation. This also adheres with the work of Sanders & Stappers (2008) who place co-creation within the tradition of participatory design. They define co-creation as any act of collective creativity, i.e. creativity that is shared by two or more people, which makes this a very broad term. They see co-design as a specific form of co-creation that refers to a collective creativity as it is applied across the whole span of a design process, and which takes place between designers and people not trained

in design. Within this paper, we refer to co-creation as research activities where end-user input is generated in order to advance the innovation development process of the innovation instigator. This evolution from Lead User methods towards user co-creation marks an important evolution, as traditionally, user innovation research focused on the conditions under which users would start innovating themselves and how they could be supported to be more innovative (Bogers & West, 2011), whereas now interaction methods and different user contributions are being researched beyond pure user innovation, aimed at mutual value creation between users and innovation instigators. In the next section, we will introduce a recently emerged approach facilitating user co-creation in real-life and multi-stakeholder settings: Living Labs.

Living Labs for user co-creation

Living Labs emerged on the crossroads of the open innovation and user innovation frameworks as an innovation approach facilitating user co-creation (Schuurman & De Marez, 2012). The term 'Living Lab' was originally used to describe a research facility that tries to overcome the artificial lab-context by providing a laboratory with all facilities of a regular home, optimized for multi-day or multi-week observational studies of individuals and constructed to resemble a 'real' home as closely as possible (Intille et al., 2005). In Europe this original notion of Living Labs was reinterpreted based on the advances in both open and user innovation, and the movement was given a head start by the support of EU-policy, especially in the domain of ICTs (Dutilleul et al., 2011). One of the more widespread and early definitions of Living Labs in this European sense describes them as experimental platforms that function as ecosystems where the user is studied in his or her everyday habitat and subjected to a combination of research methodologies (multi method) while they test new technologies that are still in development (Niitamo et al., 2006). A major divergence of the 'European' Living Labs from the American Living Labs is that the user is now studied in his or her everyday habitat instead of recreating a natural context in a laboratory setting. In terms of methodological set-up, this implied bringing the testing facilities to the users instead of the other

way round (Schuurman et al., 2013). Soon the EnoLL network was set up as a platform for knowledge sharing and collaboration to foster common methodologies and tools across Europe that support, stimulate and accelerate co-creative innovation processes, relying on user's involvement. Essentially, the ENoLL tries to foster "co-creative, human-centric and user-driven research, development and innovation in order to better cater for people's needs" (Prime Minister's Office, 2006a; Prime Minister's Office, 2006b).

However, when studying the different setups and conceptualizations of European Living Labs, the Living Lab concept appeared to be used in multiple ways (Eriksson et al., 2005; Ballon et al., 2007; Schuurman et al., 2013). Frissen & van Lieshout (2004) define Living Labs as consciously constructed social environments in which the uncontrollable dynamics of everyday life are accepted as part of the innovation environment which enables designers and users to co-produce new products and services. This early definition focuses on user involvement and on the everyday context as an important divergence from more traditional views on innovation. Ståhlbröst & Bergvall-Kåreborn (2008) mention co-creation explicitly as they state that Living Labs are a means to gain access to the ideas, experiences, and knowledge that users possess, built upon co-operation with users to support creativity, so an efficient interaction with a larger population of people should be facilitated. They position Living Labs within a strong user-centric approach but do not stress the everyday habitat.

In academic literature, the Lead User-concept is mentioned a few times in relation to Living Labs, but the exact nature of the integration of the Lead User-concept or with user innovation with the Living Lab-concept remains unclear (Schuurman & De Marez, 2009). This is quite surprising, as Living Labs are grounded in user-centric innovation. Sauer (2013) provides the most comprehensive study of user conceptualizations in Living Labs to date, analyzing 130 Living Labs from the European Network of Living Labs. The largest proportion of Living Labs do not provide a representation of users in Living Labs, other representations include user as stakeholder, user as co-creator, user as participator and user as tester/evaluator. User as (co-)innovator comes only in fifth place, which indicates that Lead

User/innovating user vision on user innovation is not dominant within the current Living Lab-practice. This is even more apparent as in the user inclusion methods there is even no trace to be found of Lead User methods. According to Turkama (2010), one of the main principles of Living Labs is that crowdsourcing the people's wisdom leads to smarter products/services. This incorporates the vision of involving 'ordinary users' and that the Living Lab-process in itself will be able to extract the right input from the users. However, it is not clear how a Living Lab extracts the 'right' input from users and what kind of users should be involved, besides 'ordinary users'. Moreover, through their multi-method character, Living Lab projects are perfectly suited for experimentation with different usrr involvement methods and allow to incorporate users in multiple stages of the innovation development process. Therefore this paper will try to provide an answer to this gap in the Living Lab literature.

User characteristics and user contribution

Within this section, we will review the literature on user characteristics for innovation and abstract some hypotheses regarding what kind of user would be able to generate what kind of contribution. Lüthje (2003) ascribes the ability of Lead Users to be effective contributors to the innovation process to two major characteristics: **adequate technological expertise** and superior knowledge of the user domain '**use experience**'. The first characteristic can be seen as a prerequisite to the innovating user-criterion, as it requires some technological skills to be able to innovate or modify, whereas the second characteristic suggests that intensity of use is a characteristic of Lead Users. Franke et al. (2006) see both characteristics as part of the variable expertise, consisting of two elements: product and domain related knowledge, which also refers to more technological knowledge, and usage related knowledge (use experience). This is an interesting discrepancy compared to Lüthje, as Franke et al. (2006) distinguish between more general technical knowledge regarding the innovation domain and product or innovation specific technical knowledge. However, they do not make this distinction for the usage related knowledge. Therefore, we propose a distinction between 'domain related

usage knowledge' and 'innovation specific usage knowledge'. This distinction is particularly relevant in Living Labs, as users can have real-life experience with the innovation in development.

Lüthje (2003) and Piller & Ihl (2009) argue that technical expertise to develop new solutions may qualify an 'expert user' to stimulate technical innovation and assist in the development of products that are technically feasible, while the usage-related experience can generate more application-oriented ideas and feedback. In terms of types of contribution, technological knowledge would lead to solution information, whereas usage knowledge would provide need information.

Recently, some authors criticized the involvement of 'Lead Users' or users with specific characteristics. Magnusson (2009) states that too much expertise and knowledge may inhibit the development of novel, original and creative knowledge. Kristensson & Magnusson (2010) also state that, in the context of service innovation, 'ordinary users' with contextual use experience and without too much restriction (caused by fundamental technological expertise or knowledge on the potential feasibility), are able to provide innovative ideas. The involvement of 'ordinary users' is linked here specifically to ideation, but in the context of Living Labs and of testing, we can argue that 'ordinary users' can also provide general feedback on usability and user experience, as they can be seen as a representation of the future market, as Turkama argued (cf. supra). Table 2 provides an overview of the hypothesized user contributions related to the user characteristics, based on the literature review.

[Insert table 2 about here]

Poetz & Schreier (2012) researched the characteristics and motivations of participants in an online idea generation contest. They found that participating users tend to have experience with the underlying problem, a sound technical knowledge of the related products, score higher on Lead User characteristics, they have high expected benefits from innovations and being ahead of a trend, and creative personalities. However, none of these measures appeared to be significantly correlated to the quality of the submitted ideas. The quality of the submitted ideas was assessed by an expert

panel. The authors also concluded that not all participants were true Lead Users, but that the crowdsourcing process had attracted qualified users to participate. When compared to ideas from professionals, the user ideas scored even higher in terms of novelty and customer benefit, and slightly lower on feasibility. This leads us to hypothesize that in Living Labs, due to self-selection, a similar effect takes place: the filtering of users with relevant contributions to the innovation process. In other words, can regular users also contribute to radical innovation? Should innovation research focus more on interaction methods and different user contributions instead of pure user innovation? To what extent can Living Labs be applied as a manner of user co-creation in real-life and multi-stakeholder settings?

Comparative case study analysis

In order to explore these hypotheses regarding user characteristics and their relation to user contribution to co-creation in Living Labs, we conducted a comparative case study analysis. Because of the exploratory nature of this research, a comparative case-study analysis is the most suitable approach (Yin, 1984). Case study research excels at bringing an understanding of a complex issue and can extend knowledge or add strength to what is already known through previous research. On top of that, case studies are particularly suited for processes that are poorly understood and lack a (solid) theoretical foundation (Eisenhardt, 1989). They allow analyzing the process open-ended on multiple levels (Yin, 1984) and gain deeper qualitative insights. Yin defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used. We will analyze the data and results from three Living Lab cases,

carried out in the context of iLab.o[1], the Living Lab division of the iMinds research institute[2] with researchers from Ghent University conducting the research.

In all three cases, users were recruited via online questionnaires or were invited to participate in the session without prior knowledge. The participants of the co-creation sessions were segmented based on their usage experience and technical knowledge of the innovation domain and/or of the innovation itself. Each case followed the path of expression (Sanders & Stappers, 2012) during the co-creation session, making comparison within and over all cases possible. There are four steps in the path of expression: 1. Immersion into current experiences 2. Activating feelings and memories of the past 3. Dreaming about possible futures 4. Generating and expressing new ideas relating to the future experiences (see figure 1).

[Insert figure 1 about here]

We will first briefly situate the cases and then elaborate upon the characteristics of the involved users and relate these to their contributions. For every case, we summarize the main findings regarding the proposed hypotheses.

Results & findings

Case 1: iCinema[3]

The iCinema Living Lab-project involved different stakeholders from the movie industry such as companies and cinema-goers in order to explore the potential and possibilities of interactive cinema

[1] http://www.iminds.be/en/develop-test/ilab-o
[2] http://www.iminds.be/en
[3] http://www.iminds.be/en/research/overview-projects/p/detail/icinema-2

formats. The goal of the project and of the co-creation sessions was clearly exploratory and aimed at ideation and generation of use cases. The participants of the iCinema co-design session were cinema goers selected via a questionnaire (n=1372). A segmentation was made, based on their technical and usage knowledge. As presented in table 3, four segments were uncovered and invited to the co-creation session.

[Insert table 3 about here]

Participants from different segments were then invited to join the session and could bring a friend if wanted (= 'ordinary user'). If too many respondents showed up for a session, the session was split up into different groups. Table 4 provides an overview of the organization and set-up of these sessions.

[Insert table 4 about here]

Depending on the segment one belongs to, we expect different needs to arise and different solutions for those needs to be suggested. Therefore, we experimented with the group composition in the three sessions.

The first session being organized had different segments present and included two groups. One group was rather homogeneous with users that all had a high technical knowledge. They came up with a solution based on their own personal needs and on the their technical knowledge. They suggested extra features and possibilities for the current movie theater app, including more advanced options and solutions like location-based services and QR-codes. However, their concept did not take into consideration the needs of the less digital movie visitors. The second groups consisted of a mix of users with high technical knowledge versus users with high usage knowledge. They rather combined their ideas and looked more for concepts and solutions that were suited for a broader population. However, the proposed concepts were less advanced in terms of ideas as well as in terms of the maturity of the concept. More specifically, they focused on the movie lobby and looked at ways to pass the time while waiting, such as games.

Despite the fact that these results suggest we need to invite people from diverse segments to find different needs, we noticed that people from the same segment discuss more when being in the same group. This might be caused by a similar level of domain specific knowledge, allowing for more profound discussions. Although it seems harder to come to a solution for a similar group, these solutions seem well thought out. This was the case for the second session, where only one group was active with most participants belonging to the third segment, which had a high usage experience. This grouped started discussing about interactivity in the movie theaters at a completely different level than the other groups. The topic they wanted to share their opinion on was the alternative ending of a movie. The discussion went on a deeper level because these movie visitors belonged to the segment that has a lot of domain specific knowledge about the topic.

Participant A: *"At work we have to vote controllers, called power vote. Everyone receives it and during a presentation questions will be asked, and you can vote, the answers will be given in the presentation."*

Participant B: *"You would be able to determine the end of a movie with that."*

Participant C: *"Do you know horse by committee?" "It is an expression in Hollywood meaning that if you let too many people decide it will become a horrifying… I am not talking about the creative part here…"*

Participant D: *"I like the movie to lead me through the story, I want to be inspired and let the story grow."*

Participant E: *"A movie is like an artistic process, the question is do you need to change it?' 'It is like looking at the Mona Lisa and thinking, I would have liked this in a different way."*

This discussion continued for a while without reaching any agreement on the topic itself, but moved on towards second screen opportunities during the movie and the opportunity to provide a recap of the movie during breaks. Additionally they came up with some ideas to lower the price of movie tickets, one of the biggest critiques of all movie goers. Although the session at first glance appeared to be more discussion than agreement, some original ideas came out of it. These results are not in line with what previous research stated on dissimilarities between users leading to more discussion (Sanders & Stappers, 2012).

In the last session we invited some 'friends' of the segmented users, with no prior relationship to the research, which we label as 'ordinary users'. It appeared that including this user type with no specific innovation domain related knowledge within all three groups that participated in this session widens the scope of the creative process. When the ideas of one group were presented to the entire group, it were these 'ordinary users' that started to elaborate on those ideas. One of the ideas was to expand to mobile usage in the movie theater such as paying for food and drinks with your mobile but also being able to add trailer being played in the foyer to your wish list via a QR code you can scan.

Friend A: *"You can also have a QR code in the street that triggers you to see a movie and brings you in the theater."*

Friend B: *"Or think about 'Good Read', this is a website that is working with QR codes and there should be something similar for the movie industry so you can easily use this."*

Friend C: *"Yes, Like the wish list on Amazon."*

Participant: *"But Kinepolis already has something like that."*

Friend D: *"It would be nice to share this with friends so you can see who is interested in seeing a certain movie and then you can go together, they don't have that yet."*

The users selected through the survey were better at generating initial ideas, whereas the 'ordinary users' were rather passive during this stage. However, when all initial ideas were gathered and discussed, the roles shifted and the 'ordinary users' were far more active elaborating and fine tuning the ideas towards more generally appealing concepts.

Findings

In this case, users with the deepest innovation specific knowledge provided innovative ideas that were suited only for a technical niche and less to a larger public, whereas users with a high general knowledge of the innovation domain provided the most innovative ideas that were suited for a more general audience. The mixed groups were better able to end up with a more mature concept, whereas the homogeneous groups ended with more diverging ideas. This suggests that users with a similar amount of innovation domain related knowledge are able to more profoundly discuss and

ideate based on their shared knowledge, whereas the mixed groups are more likely to come to a consensus. The data from this case also suggest that 'ordinary users' might have an important role within the innovation development process, as they seem to be suited to further develop ideas and suggestions from users with more technical and usage experience, and that they are also able to include some kind of reality check for the ideas of the more knowledgeable users.

This contradicts our hypotheses in the way that 'ordinary users' do not generate the most 'out of the box' ideas, but are able to co-shape the ideas from users with a high innovation specific knowledge. Users with a high technical knowledge, seem to provide ideas that are too advanced for the general market, which confirms the need for 'ordinary users' to assess the future market.

Case 2: neoScores[4]

The neoScores Living Lab project deals with a digital solution for music scores through an application on tablets. The goal of the co-creation session was to evaluate the neoScores solution, which could be tested during the session, and ideate regarding additional applications and features. The participants of the neoScores co-design session were partly selected through a questionnaire (n=912) that surveyed the neoScores concept (which provided these users with innovation specific knowledge), and partly recruited from the general iLab.o user panel and through social media (i.e. users without innovation specific knowledge). One session was organized wherein the participants were divided into three groups based on two parameters: whether they filled in the survey (innovation specific knowledge), and whether they are interested in digital sheet papers (innovation domain knowledge and usage). The second parameter was measured when the participants arrived at the co-design session. Based on these parameters three groups were established.

[Insert table 5 about here]

As presented in table 5, the participants of this co-design session who are interested in digital sheet music (Informed digital score lovers & Uninformed digital score lovers) are positive about the current

[4] http://www.mict.be/projects/current-projects/neoscores

process on searching sheet music, while the participants who are less interested in digital sheet music (Uninformed paper sheet preferers) have mainly negative experiences in both searching and using sheet music. This can be explained by the fact that the participants, who are interested in digital sheet music, already use digital applications or websites to find their desired sheet music. A digital search and purchase of sheet music takes less time than going to a music store, searching through the collection of the store, buying the sheet music and going home to play the music. The three groups have negative experiences about the use of sheet music. This can be explained by the fact that nowadays the majority of digital sheet music is a scanned version of paper sheet music. The participants had to sum up negative and positive experiences about both searching and using digital sheet music (table 6).

[Insert table 6 about here]

The second part of this co-design session consisted of a pitch of the neoScores concept. After this introduction, participants could test a demo version of neoScores on tablets. Based on paper mock-ups, participants could indicate modifications or additional features for neoScores.

In general, when going through the paper mock-ups and transcripts of the session, the informed digital score lovers were very positive about neoScores. Their remarks were mainly dealing with the lay-out of the application. The uninformed digital score lovers and the uniformed paper sheet preferers were slightly less positive about neoScores. The uninformed digital score lovers had the most questions about the current version of the application, and suggested some fundamental changes to improve the usability based on their current workflow, which we can label as 'advanced usability issues'. The remarks of the uniformed paper sheet preferers were about functions they missed in the current version of neoScores. Remarkably, most of these features were already available in the app, which indicated that they were not able to use it properly because of a lacking knowledge of tablets. Stated differently, this group identified 'basic usability issues' that would arise when less knowledgeable users would adopt the innovation.

Findings

In the neoScores case the users with the highest innovation related knowledge suggested smaller corrections or modifications in terms of the user interface. It seems that users with high general usage knowledge, but without any innovation specific usage or technical knowledge where the most critical towards the innovation and tried to provide new feature ideas, but instead identified basic usability issues. The users with no innovation specific knowledge but with high general technical knowledge were critical and suggested more advanced usability issues. In general, the users with the highest innovation related knowledge appeared to be the most positive towards the innovation. In terms of our hypotheses, this contradicts what we expected, as users with less innovation specific knowledge seemed to generate more application suggestions, which would suggest they have more innovation-specific needs. The 'ordinary users' within this case were also not able to generate 'out of the box' ideas, but came up with suggestions that were already integrated in the app. However, the small corrections and changes in the interface suggested by the users with a high knowledge of the innovation can be seen as a confirmation that these users are better able to generate application-related solution information. Also, it seems that this type of session is able to identify certain issues and to capture the attitude towards the innovation of different user groups, but that a more in-depth (usage) knowledge (e.g. through a field trial) is required for additional feature ideation.

Case 3: AllThingsTalk[5]

The start-up company AllThingsTalk (ATT) wants to develop an open-sourced and cloud-connected Internet of Things (IoT) platform that enables Smart Living Solutions for end-users, DIY'ers and developers. The ATT platform can provide solutions for and have a major impact on several domains of the Smart Living paradigm such as home entertainment and security, health care, family management and energy monitoring. In order to persuade the end-user of this platform (i.e., to show the added-value of this online platform, what's in it for the user?), AllThingsTalk needs to develop

[5] http://events.iminds.be/en/smart-living-day

tangible use cases that can be connected to the online platform. A multi-method approach investigating the users' needs and wants was applied, aiming at the development of concrete use cases. The Living Lab research track started off with an extended desk research, an ideation workshop, an online survey and a probe research in order to define concrete use case scenarios (Smart Living Kits). The majority of the ideas for use-cases originated from the so-called DIY'ers, users with a high degree of product-related and usage knowledge. These ideas were also more advanced than the ideas from users with less innovation related knowledge, who submitted mainly straightforward and obvious use cases.

Next, in three co-creation sessions, participants composed and evaluated the use case scenarios to be implemented in the online ATT platform. Also, product specifications of the Smart Living Kits were discussed and in-depth insights on privacy, security and data logging were collected. The participants of the co-creation session were purposefully chosen based on different variables from the pre-survey (n=234). A segmentation was made based on their adoption profile (according to Everett Rogers' innovation adoption diffusion model), willingness to contribute to the ATT platform (i.e., willing to test the product or develop use case scenarios), ownership of home control systems and attitude towards IoT. Two types of possible users were discovered, namely high-skilled users and low-skilled users. High-skilled users are mostly innovators and early adopters and they are positive and enthusiastic towards IoT and ATT, while low-skilled users are more preserved. Table 7 shows the distribution of participants over the three sessions.

[Insert table 7 about here]

We decided to organize two separate sessions with homogenous groups and one session with a heterogeneous composition to test the effect of user characteristics on the evaluation of co-created use-cases. We first organized a session with high-skilled expert-users that were very enthusiastic towards the ATT platform. This was followed by a session with low-skilled users (i.e., low computer knowledge and with a more wait-and-see attitude towards ATT). The outcomes of these two sessions

were subsequently merged and discussed in a session with high- and low-skilled users. The goal of this last session was to compromise the visions of different types of users and to translate this into four use case scenarios of the Smart Living Kits.

The high-skilled and low-skilled co-creation sessions followed the same structure. In a first section, the moderator started with asking the participants what their vision on Internet of Things was. Next, in-depth questions were asked on privacy, security, logging of data and monitoring of elderly and children. Next, the participants were divided in two groups and were asked to prioritize and give feedback on possible use-cases for the platform that came out the online survey and probe research. The outcomes of each group were presented to the whole group and discussed. In a final section of the co-creation session, the instigator of AllThingsTalk gave a pitch on the ATT platform and the Smart Living Kits. Subsequently, feedback was gathered from the participants and suggestions were collected as input for the ATT business model.

[Insert figure 2 about here]

The mixed co-creation session was structured differently. The session started with a pitch on ATT and the Smart Living Kits, feedback was collected briefly and then the participants were asked to make storyboards of what they would do with the Smart Living Kits in their own daily lives (Figure 2). The participants were divided in two groups to make the storyboards. Afterwards, their ideas were presented to the other group and discussed. Also, in the mixed co-creation session a creative brainstorm (Figure 3) was organized in order to gather input on the possibilities of different business models and on marketing related aspects of the Smart Living Kits.

[Insert figure 3 about here]

The participants of the high-skilled and low-skilled session have a clear vision on what IoT is and they could sum up some IoT products (e.g., Nest Thermostat, Phillips Hue,…). The high-skilled participants have a holistic view, see more benefits in IoT and realize more that IoT can solve problems or frustrations of their daily lives. The low-skilled participants had a more narrow view on IoT and saw it especially as receiving notifications from things (e.g., refrigerator, TV, flower pot,…).

High-skilled participant: *"The trend grows towards smart, cheap and integrated devices that enable the end-user to save time and have more comfort. If an IoT system enables you to connect devices in an easy way, it will be a trigger for large-scale diffusion."*

Low-skilled participant: *"It should enable me to get a notification if the trash bin has been blown away by the wind."*

The motivations for non-adoption were similar for the high- and low-skilled participants, namely, IoT is too expensive and in most cases the added value of the systems lacks. The motivations for adoption slightly differ between these types of users. High-skilled users would be more likely to adopt an IoT product if the user has the possibility to extend the product (i.e., make applications, develop use cases for the platform, make it more personal). The low-skilled users would adopt an IoT product more easily if the usability is very good, if customer support is high and if the personal advantages can be shown (e.g., save 200 euros per year on your electrical bill when you buy a Smart Living Kit).

The opinions on privacy and the IoT differ between the groups of participants. High-skilled users are aware of the fact that data can be logged and they don't mind that data is being logged if there is a personal benefit for them. Low-skilled users are more preserved and would rather not have that their data is logged. They are also more afraid of hackers and privacy breaches than high-skilled users.

According to the participants, the most favorite Smart Living Kit would be the Energy Saving Kit because it offers both comfort and saves money. This was most prevalent in the session with low-skilled users and in the mixed session. In the high-skilled session the different kits were found equally interesting. This was also seen as a positive aspect, since it is good to differentiate between different

user groups. The participants had no clear idea on how much they would be willing to pay for each kit. As for logging of data via the online platform, the overall opinion is that data can be logged, preferably not for commercial purposes and the user has to be aware which data is logged, what it is used for and the user should be able to decide whether data would be logged or not. The feedback on the online platform and the Smart Living Kits were mostly positive and most of the participants would use them. However, there should be more attention for a fun perspective in the kits and the kits should be usable for low-skilled users as well (i.e., clear instructions and easy to use).

Findings

Within the AllThingsTalk case, we noticed that users with the highest product-related knowledge and usage experience were the least critical towards the innovation and were in favor of all proposed use cases. Users with less usage experience and product-related knowledge were more critical and had a clear preference for one of the use cases. Interestingly, the mixed group was quite similar to the low skilled group, which suggests that the less skilled users influenced the high skilled users, and not vice versa. In terms of our hypotheses, this seems to confirm that more 'ordinary users' are more critical towards the innovation and are better able to assess the future market, whereas users with high technical and usage knowledge are better at generating innovative use cases, but tend to be less critical towards these various use cases. Moreover, the high-skilled and experienced users seem to be influenced by the low-skilled and more inexperienced users. This finding suggests using 'ordinary users' for evaluation and prioritization purposes.

Discussion & conclusion

In order to explore our hypotheses regarding user characteristics and their relation with user contribution in Living Labs co-creation sessions, we conducted a comparative case study analysis. In all three cases, various opinions on the innovation could be noticed between the different user types. In table 8, the main contributions are linked to the different user types.

[Insert table 8 about here]

Involving different segments results in a more fain grained picture, because in this way multiple needs arise that can be taken into account. On the other hand, when different needs should be mapped out in group by people from different segments –as was the case for iCinema- a challenge arises as contrary opinions can block the creation process. Therefore it might be interesting to group people from the same segment as was the case for neoScores and AllThingsTalk. Although we need to invite users from diverse segments to find different needs, we noticed that people from the same segment discuss more intensely. This conclusion is not in line with previous research on dissimilarities between users leading to more discussion (Sanders & Stappers, 2012). In all three cases, friends of research participants were invited as well. This widens the scope of the creative process, as users participating in multiple research steps enhance their expertise in the innovation specific domain (they get acquainted with the innovation), whereas the users that are new to the project have no innovation specific knowledge at all. Our findings suggest that varying the level of innovation related knowledge in co-creation sessions yields more diverse results.

More specifically, this case study suggests that 'ordinary users' seem to be able to further develop ideas of users with more technical and usage experience. Users with a deeper innovation specific knowledge provide innovative ideas that are focused on a technical niche public. Users with a high general knowledge of the innovation domain provide the most innovative ideas that are suited for a more general audience. This comparative case study also shows that it is not always the case that users with high user experience and a high technological knowledge are more critical about the innovation. We could notice the exact opposite for the both the neoScores as the AllThingsTalk cases. This emphasizes the need for various terms of user involvement, because taking into account the user feedback of only one segment of users risks to provide single-sided views and input regarding the innovation.

Within this paper, we have investigated the nature of user contribution related to the characteristics of the contributing users. We have put forward the following relevant dimensions for user selection: usage experience and technical knowledge. We have argued that these dimensions should be used on two levels: first on a general innovation-domain related level, indicating experience and/or knowledge of the current products or solutions on the market, second on an innovation-specific level, indicating experience and/or knowledge of the innovation itself. This distinction is especially relevant and applicable in a Living Lab-context as this innovation approach involves the users in multiple stages of the innovation development process which allows users to get real-world experience with the innovation in development. Moreover, in literature it also appeared that involving the 'ordinary user' has specific advantages. It was suggested that these 'ordinary users' are able to generate 'out of the box' ideas, but in the studied cases these users were especially relevant evaluate different solutions and to elaborate upon the ideas formulated by the other user types. It also appeared that users that are involved in multiple research steps, and gain innovation specific knowledge and usage experience, risk to become less critical towards the innovation.

A purposeful sampling of the relevant characteristics (based on a pre-survey), coupled with a self-selection mechanism for the involved users (the selected users were free to decide whether they wanted to participate or not), seems to yield satisfactory results. The user characteristics can be manipulated within one session by splitting the participants into different groups or by having multiple sessions with different groups. However, future research is needed to further explore other dimensions and to assess more long-term effects of user characteristics related to user contributions on the innovation. Dimensions that were left untouched in this paper are user motivations to participate and personality-related characteristics (such as innovativeness, opinion leadership, etc.). Moreover, our results should be validated in a larger setting, taking into account multiple cases and a longer time-frame to assess the value of the user contributions.

Nonetheless, our exploratory multiple case study analysis of user co-creation in three Living Lab-cases demonstrated that innovation related technical and usage knowledge seem to have an impact on the user contribution, but also on the attitude towards the innovation. Within co-creation sessions, higher innovation specific knowledge seem to have a positive impact on the attitude towards the innovation. This highlights the need for variation in terms of user involvement, as only listening to one type of user risks to provide single-sided views and input regarding the innovation. Moreover, it also became apparent that the 'ordinary user' is able to play a crucial mediating and evaluating role within these sessions.

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Table 1. The two perspectives on user innovation

Voice-of-the-Customer	User co-creation	Lead User methods
MAP		CAP

Table 2. Type of users and hypothesized contribution in co-creation sessions

	Innovation domain	**Innovation specific**
High technical knowledge	General solution information	Application-related solution information
High usage knowledge	General need information	Application-related need information
Ordinary users	'Outside the box' ideas & future market assessment	

Table 3. Segmentation for the iCinema case

Segment	**Usage Knowledge**	**Technical Knowledge**
Segment 1 (n=329)	High	Average
Segment 2 (n=439)	Low	Average
Segment 3 (n=343)	High	Low
Segment 4 (n=261)	Average	High

Table 4. Session and group division for the iCinema case

Session 1	Session 2	Session 3
Two groups: Homogeneous group with high technical knowledge Mixed group with high technical knowledge & high usage knowledge	One group: Homogeneous group with advanced usage knowledge	Three mixed groups including ordinary users

Table 5. Division of participants of the neoScores co-design session

Informed digital score lovers (n=6)	Uninformed digital score lovers (n=8)	Uninformed paper sheet preferers (n=5)
Participants filled in the survey and are interested in digital sheet music	Participants did not fill in the survey and are interested in digital sheet music	Participants did not fill in the survey and are less interested in digital sheet music

Table 6. Results of the affinity maps of the three tables of participants

Theme	Informed digital score lovers	Uninformed digital score lovers	Uninformed paper sheet preferers
Searching sheet music	Positive	Positive	Negative
Using sheet music	Negative	Negative	Negative

Table 7. Distribution of participants over three ATT co-creation sessions

	Co-creation session 1: High skilled participants	Co-creation session 2: Low skilled participants	Co-creation session 3: Mixed participants
N	8	8	8
Adoption profiles	4 Innovators 4 Early Adopters	2 Early Adopters 6 Early Majority	2 Early Adopters 2 Early Majority 2 Late Majority 2 Laggards

Willingness to contribute to ATT	Consumers Contributors	Consumers	Consumers (Contributors)
Attitude towards IoT	Enthusiastic	Preserved	Preserved
Home control system owners	4	1	1
DIY'ers	3	0	0

Table 8. Comparison between the contributions of the different user types

Case and user type	Usage experience	Technical knowledge	Contribution
iCinema: segment 1	High	Medium	General need information Solution based application
iCinema: segment 2	Low	Medium	Solution based application
iCinema: segment 3	High	Low	Application related need information
iCinema: segment 3	Medium	High	Radical innovation (niche)
neoScores: informed digital score lovers	High	High	User interface
neoScores: uninformed digital score lovers	High	Low	Usability issues
neoScores: uninformed paper sheet preferers	Low	High	Additional or different features
AllThingsTalk: high skilled	High	High	Least critical
AllThingsTalk: low skilled	Low	Low	Most critical

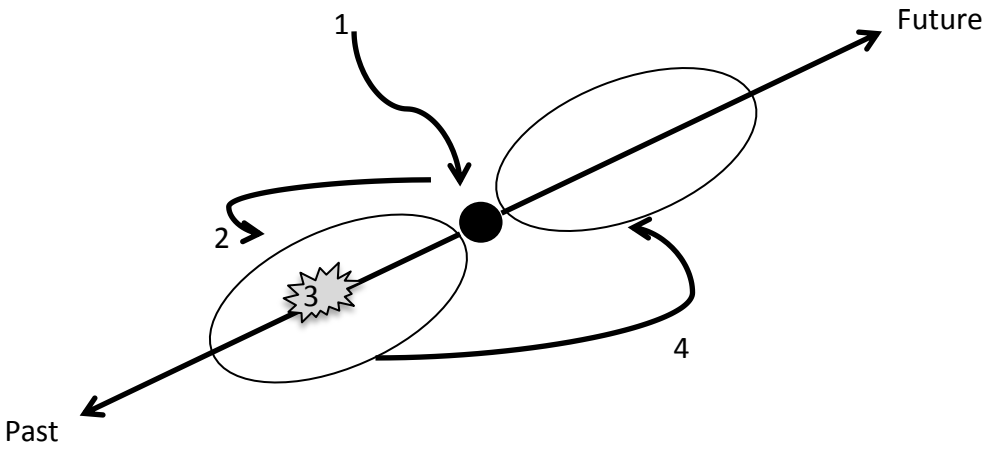

Figure 1. Path of Expression adapted from Sanders and Stappers (2012)

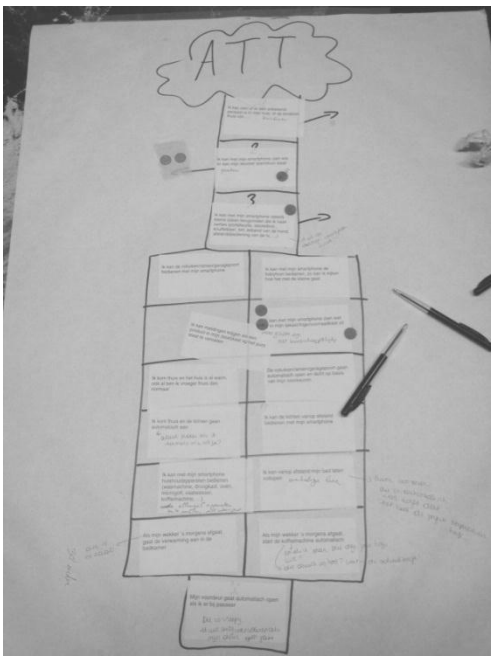

Figure 2. Prioritization of use case scenarios in low-skilled co-creation session

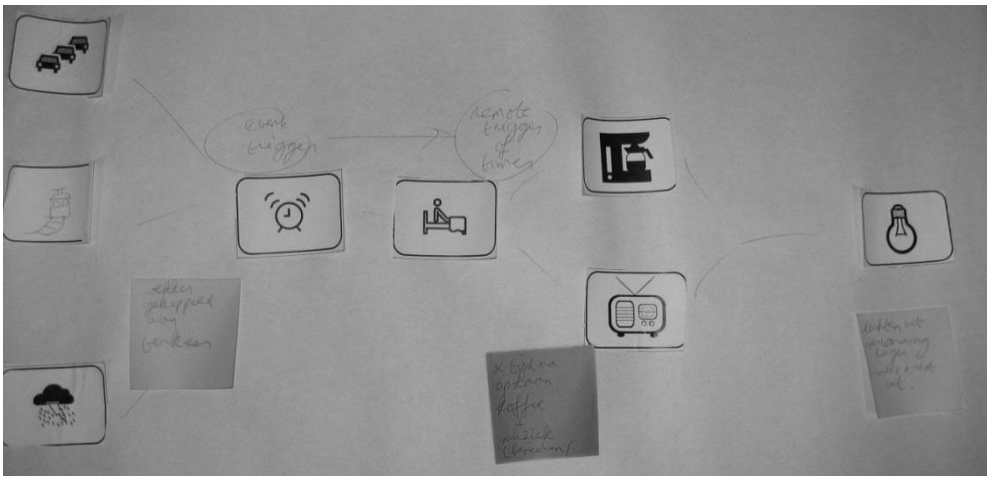

Figure 3. Storyboard from mixed co-creation session