

Guidelines for Facilitating User-Centric Product and Service Development in an Open Innovation Environment

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Abstract—This paper proposes guidelines for facilitating user-centric product and service development in an open innovation environment. Well-working open innovation processes and practices are key factors for involving different stakeholders into innovation and evaluation of new product and services. The purpose of these guidelines is to help create and improve open innovation environments and practices to increase the usefulness of innovation environments, and to take user experience aspects more broadly into account. The guidelines are developed based on the empirical experiences and lessons learned from case studies conducted in an open innovation environment during several years. The guidelines support adoption of open innovation environment practices in a variety of product and service development activities.

I. INTRODUCTION

The importance of users in generating commercially viable innovations has been recognized for decades, as, e.g., von Hippel introduced the concept of *user innovation* and *lead user* in the 80s [1],[2]. As the *open innovation* (OI) approach [3] emerged in new service development, elaborate networks in which companies co-create to generate new products and services have been increasingly researched and established. [4],[5]. The main shared thought in user innovation and open innovation research is the need for external knowledge for innovation [6]. According to Wilkinson and De Angeli [7] among others, the inclusion of users throughout the design process is crucial to the improved adoption of finalized solutions. They point out that the investigation of user needs has been prosperous, especially for the development of new products. The significance of open innovation and end-user involvement has been recognized also at the European Union level where the living labs strategy was established in the 2000s by the European Commission and furthered with the Open Innovation Strategy and Policy Group that promotes open and collaborative innovation processes [8],[9].

The *open innovation* is a broad concept of which several definitions exist as scholars and practitioners hold their own type of definitions [6],[10]. For the past decade, the concept has increasingly gained popularity within academic research, practitioners and policymakers. [11],[12] The concept of open innovation, originally introduced by Henry Chesbrough [3], encouraged companies to acquire outside sources of innovation to improve products or services and to shorten the

time required to bring products into the market, and to market or internally release the developed innovation that does not fit the company's business model but could effectively be used elsewhere.

Living lab approach has become popular in involving users into innovation and evaluation process of products and services and has been under the investigation since the 2000s. However, there is a need for further studies on the living lab processes and methods [13],[14]. Living labs operate as *intermediaries* among citizens, research organizations, companies, cities and regions for joint value co-creation, rapid prototyping or validation to scale up innovation and business. Living labs are driven by two main ideas: involving users as co-creators on equal footing with the other participants and experiments in real-world settings [15]. As the multi-method approach is characteristic to living labs, a broad variety of user involvement methods have been utilized in living lab activities. Tang and Hämmäläinen [16] describe the living lab as a concept and methodology, which combines different types of research methods including traditional and ICT-enabled methods.

Unlike a single field trial or a user test (e.g. usability test), open innovation environment (e.g. living lab) approach involves users in all stages of research and development and the product development lifecycle. The approach is relevant especially when studying comprehensively user experiences before, during and after the use of products or services [17]. User experience (UX) is a significant factor for the success of products, and thus just good usability is not enough anymore [18],[19]. This is one reason why UX has become a central target in product and service design [20]. Over the last two decades, the term user experience has spread everywhere in research and industry. A wide interest on UX over two last decades has changed the term from a buzzword to a considerable key asset of business and development. General public seems to use the term UX as a synonym for user interface and usability. However, user experience is not the same issue than user interface or usability. Instead, user experience has a larger meaning and both user interface and usability of the product or services have influences on subjects' user experiences. ISO 9241-110:2010 standard defines user experience as: "*a person's perceptions and responses that results from the use and/or anticipated use of a product, system or service*" [21]. Especially studying

anticipated user experiences (AUX) in the early phase of the development process can provide valuable inputs and insights for the design of new product and services [22]. Even though the interest in user experience in industry and academy has been high for a long time, there been recognized lacks of finding systematic methods for UX research and take UX issues into account in different phases of the design and development [17],[22]. In an open innovation environment, one challenge is to find the most suitable methods for different phases of the open innovation process (e.g. user involvement, co-creation and UX evaluation). It is important to choose the right methods to support several ways of user participation and collection of experiences, ideas, values and opinions. This will have influences also on how to motivate users [23] to participate in open innovation environments (OIE). Therefore, it is important that processes and practices in OIE can support efficient user involvement.

In this paper, we propose guidelines for facilitating user-centric product and service development in an open innovation environment. The aim of these guidelines is to facilitate creating and improving open innovation environments (e.g. living lab) and practices in order to enhance the value of innovation environments. Moreover, the aim is to support for taking user experience aspects broadly into account to build a diverse user database, motivate online and on-site user participation and provide valuable experiences and results for innovation environment stakeholders including end-users. Therefore, these guidelines were evaluated by utilizing user experience heuristics.

II. RELATED WORK

In this chapter we present related work regarding open innovation, living labs and user experience. In a user-centric product and service development in open innovation environments it is necessary to have knowledge of the user experience research and human-computer interaction research. The guidelines presented in this paper are inspired by the general heuristics and design approaches that have been developed and utilized in the field of human-computer interaction (HCI) during the last three decades [24],[25].

A. Open innovation approach

The importance of users in generating commercially viable innovations has been recognized for decades. Von Hippel introduced the concept of user innovation already in the 80s [1],[2]. After the open innovation approach [3] was introduced in new service development, elaborate networks in which companies co-create new products and services have been increasingly researched and established. [4],[5]. The main shared thought in user innovation and open innovation research is the need for external knowledge for innovation [6]. According to Wilkinson and De Angeli [7] among others, the inclusion of users throughout the design process is crucial to the improved adoption of finalized solutions. They point out that the investigation of user needs has been prosperous, especially for the development of new products.

Living labs are an example of organizations or intermediates that deploy the open innovation approach. To increase the understanding of the benefits of the living labs it is important to

explore the real-life living lab activities conducted in the innovation environment. According to Bergvall-Kåreborn and Ståhlbröst [26], a living lab can support innovation processes by enabling users to elaborate and evaluate the value of the service in their context. From the research perspective, the shift towards a more user-centric development of products and services has created a fruitful and unique research environment in which new methods have been developed and piloted in diverse environments; public and private sector developers, as well as research institutes, have been involved and for the first time in this scale, end-users have become equal co-developers.

B. User experience approach

The products and services should provide good user experiences in order to success, and thus UX approach has become a central target in product and service design and evaluation and new methods have been developed for UX research during the last two decades [18],[19],[17]. Despite this wide interest in UX in industry and academy, there has been recognized needs for creating systematic methods for user experience research [17]. In many expert evaluations, Ten Usability Heuristics [25] are still the most used criteria, even though the approach in them is quite narrow focusing only on usability aspects. However, when taking user experiences into account the approach needs to be wider. Especially in open innovation environments it is needed to ensure that new services and products can form positive experiences for users.

Alben [27] introduced the first general UX criteria for effective interaction design. Väänänen-Vainio-Mattila and Wäljas [20] have presented service UX evaluation heuristics. Korhonen and Koivisto have created playability heuristics for mobile games [28]. Colombo and Pasch [29] have presented ten heuristics for an optimal user experience from flow theory perspectives and then applied them to the HCI area. A flow experience [30] is an optimal experience, where a user is totally focused on person's own task and forgot all surroundings. However, it is important to notice that an optimal experience is a specific type of experience and all user experiences are not optimal.

The definition of user experience which refers to "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" [21] shows that user experience means a more comprehensive approach than only optimal experiences. All these heuristics are important, but they focus on certain specific focus area or the approach is too narrow when there is a need comprehensively to take user experience into account in user-centric product and service development. Therefore, general guidelines for user experience research have been created for design and evaluation [31] Heuristics and guidelines that professionals can utilize during the different phases of the developed are regarded as relatively low-cost methods because they can be utilized especially in the early development phases. These general user experience heuristics have been developed for any kind of product or service design and evaluation context [31].

In this paper we discuss whether these user experience heuristics can be applied in an open innovation environment context and how they should be modified.

Open innovation environments (e.g. living labs) should be a natural and continuous practice in product and service development [32], and therefore we decided to create guidelines for facilitating user-centric product and service development in an open innovation environment. The creation of these guidelines is inspired from the HCI field, but the data and experience of open innovation environments are gathered from the broad qualitative studies.

III. METHODOLOGY

In qualitative research, the benefits of the case study approach have been recognized in different fields [33],[34],[35],[36],[37],[38],[39],[40]. Yin [34],[35] defines the case study 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”. The fundamental thought beyond case research is the multifaceted view it can provide of a situation in its context [38]. The relation between a phenomenon and its context can be understood through the case study approach [37]. Compared to the quantitative research approach, depth and comprehensiveness [41] are the defining characteristics of qualitative case research. Hence, the case study enables deep understanding of a specific phenomenon and is particularly suitable for exploration of a new or unique phenomenon, for example [33]. Case study method has been criticized of lacking rigor methodology and objectivity. Johnston et al. [42] take a stance on the criticism presented towards case research by pointing out that case research is an applicable and reliable research method in business studies when the research is well-planned and theory-based, and the research design logical and systematic. Furthermore, the findings must be independently evaluated and confirmed by multiple evaluators. Essential considerations when designing case research are the definition of the unit of analysis, the selection of appropriate cases and, the decision on data collection [42].

The data collection methods utilized in this research consist of semi-structured in-depth interviews, discussions, meetings, meeting memos, workshop data, different documentation of activities, reports and data collected through a digital user involvement tool. Interviews [43] were used as the primary data collection method, consisting of altogether 70 semi-structured in-depth interview sessions [32]. In several sessions, there were multiple interviewees. The interviews were recorded, transcribed, and notes were taken. The informants were selected so that they were identified to possess a significant role in innovation activities and able to reveal important information regarding the product and service development activities conducted in the open innovation environment.

In the analysis of the data, triangulation [44],[45], thematic analysis, for instance [46], and categorization techniques were applied. Triangulation is a process in which multiple data collection and analysis methods are used to search for convergence [45]. Data collection and data analysis was also conducted concurrently as it helps identify gaps in the collected data [47],[48].

IV. AN EVALUATION OF THE INITIAL SET OF GUIDELINES

Based on the long-term studies in open innovation environments (e.g. living lab activities, user involvement, co-creation), we created guidelines for facilitating user-centric product and service development in an open innovation environment. The aim of these guidelines is to help create new and improve existing processes and practices to facilitate user-centric product and service development in the open innovation environment. The guidelines are described below:

- Functioning open innovation process
- Facilitation
- Resource-driven operations
- Funding model
- A versatile set of methods
- Digital tools
- Access to users
- Operating model for user management, involvement and motivation
- A broad network of actors
- Operating model for network collaboration
- Communication and communication of results
- Follow-up.

After creating the guidelines, we evaluated them by utilizing user experience research approach. Because one aim of the OIE is to support UX aspects to take broadly into account to build a diverse user database, motivate online and on-site user participation and provide valuable experiences for stakeholders including end-users, we decided to analyze UX heuristics in an OIE context. Ten UX heuristics [31] have been created for service and product designers and developers to take UX issues into account when making design solutions or for the evaluation of products and services. In this chapter we analyze and discuss whether these heuristics are applicable in the open innovation environment as such or are modifications needed. In addition, it will be discussed if open innovation environments require an own set of heuristics or guidelines. The Fig. 1 shows the applicability of UX heuristics compared to OIE guidelines.

		UX Heuristics									
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
OIE Guidelines	1.	A									A
	2.			A			A				
	3.										
	4.										
	5.						A				
	6.	A	A	A			A	A		A	
	7.		A	A							
	8.				A					A	
	9.					A					
	10.					A					
	11.				A						A
	12.										

Fig. 1. Applicability of UX heuristics compared to each guideline

TABLE I. ANALYSIS OF APPLICABILITY OF UX HEURISTIC FOR OIES. APPLICABLE (A= YES, N=NO)

UX heuristics	A/N	Comments
1. Ensure usability	A	The usability of the OIE process, service and tools should be ensured. The process should be functioning and smooth for all stakeholders.
2. Provide utility matching with the user's values	A	This is an important aspect to take into account in OIE as it has an influence on user participation and motivation. From a user point of view, this can relate to topics: possibilities to influence on development of products and services, civic engagement, sustainability, etc.
3. Surpass the user's expectations	A	In order to succeed, OIE should surpass the users' expectations. Users must have a clear understanding of the purpose and activities of OIE. Negative experiences can easily cause negative expectations. Enabling easy and smooth user involvement process (for companies) and diverse participating options (for users) and tools is important.
4. Respect the user	A	This is a basic requirement for the OIE, which utilizes user involvement. User management, guidance and communication should be adequate and respective throughout the process
5. Design the product or service to fit the intended contexts	A	This is important to take into account when developing a new OIE, but also when updating the existing one. Innovation in real-life context can be enabled through a broad network of actors.
6. Provide several ways to interact, leave choice for the user.	A	Because OIE can have various different users, user involvement practices should be designed as easy, versatile and flexible. Diverse tools and ways to participate should be provided for all stakeholders.
7. Respect the user's privacy and security.	A	OIE process and actors must follow GDPR. Digital tools must be designed to be secure, trustworthy and respect the privacy of users (e.g through anonymous participation).
8. Support the user's activities - do not force	A	OIE supports companies' products and service development with a user-centric approach. Users participate voluntarily. User's activity in OIE is to join the community and participate in activities on voluntary basis. OIE must take this into account in all actions.
9. Go for a perfect visual design.	A	In OIE this is related to digital tools mainly. Can be seen also relating to on-site facilities. Visual aspects can have influences on how users experience the quality of the OIE. Visually pleasurable (digital) tools can also increase participation.
10. Give a surprise gift	A	This is important especially in long-term use, when motivation of users is challenging. In the best case, the activity itself is the "surprise gift". OIE must meet the needs of all stakeholders and communicate the impact to users.

The analysis indicates that all ten UX heuristics are applicable in the OIE context and that the heuristics are important to take into account (Table 1). Especially, UX heuristic evaluation could be included into a set of methods (Guideline 5) and used for evaluating for new systems and services under investigation in OIE (e.g. when studying customers' products or services). The Fig. 1 shows that six UX heuristics are applicable with the guideline 6 (Digital tools). This indicates that digital tools of OIE should be developed by taking UX heuristics into account. However, all guidelines are not covered by UX heuristics, for instance, guidelines 3 and 4 cannot be evaluated by UX heuristics (Fig. 1). Therefore,

creating an own set of guidelines is justified. Table I shows the analysis of applicability of UX heuristics in an OIE context.

The heuristics encompass the user point of view. However, in an open innovation environment, for instance, living labs, also other aspects need to be taken into account. These aspects are, for instance, resources and networks, costs and business model, digital tools and methods, operational responsibilities and facilities among others. Therefore, it is necessary to develop specific guidelines that take the other aspects into account. Open innovation environment is a complex combination of stakeholders (e.g. customers, professionals and users), different tools and facilities, and time- and cost-dependent actions, which all will have influence on user experiences (users of OIE, end-users of product and services, customer-user and operators of OIE). The Fig. 2 shows the difference of the focus between user experience heuristics and guidelines for facilitating user-centric product and service development in an open innovation environment.

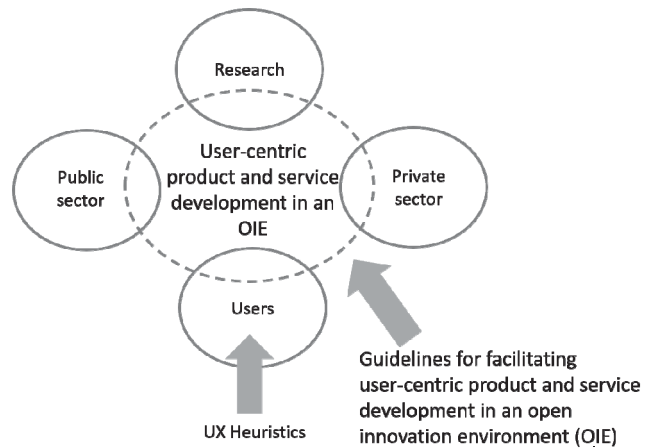


Fig. 2. Focus of UX Heuristics and OIE Guidelines

V. THE REVISED SET OF GUIDELINES

In order to facilitate a user-centric product and service development in an open innovation environment we propose guidelines which take into account the key success factors of OIE process and services. After the analysis, we revised guidelines and created the template which can be freely used for designing and evaluation open innovation environments (Fig. 3). The revised guidelines are described below.

1) Functioning open innovation process

Create a simple and smooth open innovation process where the different phases and related documentation (inputs and outputs) are clearly visible and understandable to different parties (e.g. customers, facilitators, users).

2) Facilitation

Create a set of efficient, adaptable and versatile facilitation techniques to be used in different open innovation activities (e.g. a set of techniques for certain phases of product development). Refine and apply new techniques regularly.

Guidelines for Facilitating User-Centric Product and Service Development in an Open Innovation Environment

- 0 = This guideline is not applicable with this OIE
- 1 = This guideline is not reported, or information is not found
- 2 = This guideline is not realized
- 3 = This guideline is partially realized
- 4 = This guideline is well realized

Evaluation date: _____
 Name of OIE: _____
 Status of OIE: existing OIE / new design / redesign
 Evaluator's role: designer / developer / researcher /
 external consultant / other: _____

OIE Guidelines	Points					Notes and improvement ideas. Take into account characteristics of OIE under investigation
	0	1	2	3	4	
1. Functioning open innovation process						
2. Facilitation						
3. Resource-driven operations						
4. Funding model						
5. A versatile set of methods						
6. Digital tools						
7. Access to users						
8. Operating model for user management, involvement and motivation						
9. A broad network of actors						
10. Operating model for network collaboration						
11. Communication and communication of results						
12. Follow-up						
A number of each point						

If achieved mainly points 1 and 2, there are major weaknesses or problems in the open innovation environment. It is important to do strong actions to improve the OIE process.

If achieved mainly points 3 and 4, there are some minor deficiencies in the quality of the open innovation environment. It is important to improve the OIE process according to notes.

Fig. 3. A template for checking how guidelines are realized when designing or evaluating an open innovation environment

3) *Resource-driven operations*

Ensure availability of sufficient resources and know-how from the open innovation environment network, for both permanent and temporary needs.

4) *Funding model*

Ensure public funding, project funding or other external funding (in addition to commercial activities) to enable the continuity and steadiness of open innovation environment operations (e.g. a living lab).

5) *A versatile set of methods*

Collect a set of methods that fits different needs e.g., in user involvement and evaluation. Develop methods further and apply them according to the users or customer needs in different contexts. Consider needs, timing and costs when selecting appropriate methods.

6) *Digital tools*

Digital involvement methods enable easy and smooth user involvement regardless of time and place. Develop and apply digital tools for varying needs of the open innovation environment. Pay attention to usability, visual design and security of the digital tools.

7) *Access to users*

Create a community of volunteer users and make sure you have a wide range of users involved. Develop a process for searching target-group specific users easily from the community. Keep in mind that each user experience and feedback about the product or service being tested are valuable.

8) *Operating model for user management, involvement and motivation*

Create a procedure for user community management, interaction, and communication. Improve user engagement through a range of activities, versatility, and also publicly accessible activities. Support and motivate user participation by providing various forms of interaction (online and onsite participation, verbal and non-verbal participation, device platforms: desktop, mobile, voice interaction). Reward users. Tell users that their opinion is important and provide guidance during the activity and feedback after each activity.

9) *A broad network of actors.*

Build a network of stakeholders, public organizations, research institutes and businesses that possess an interest, support, know-how and/or need for open innovation (e.g. living lab) activities.

10) *Operating model for network collaboration*

Define roles with the actors. When everyone has a clear role and goals, an open innovation environment is meaningful and effective.

11) *Communication and communication of results*

Promote the achievements and the results of the activities not only for users and the network of actors, but also for the

wider public. Create need for open innovation (e.g. living lab) services through communication of impact.

12) *Follow-up*

Create a follow-up procedure and maintain connection to your customers to stay aware of the developments of the product/service and long-term outcome of the related innovation activities conducted in the open innovation environment.

VI. DISCUSSION

In this paper, we propose a generic set of guidelines for facilitating user-centric product and service development in an open innovation environment. These guidelines have been developed on the basis of long-term qualitative studies with a broad range of open innovation cases conducted in an OIE. We see it important to share these experiences and guidelines with professionals and practitioners of the open innovation field.

However, due to the variation of different open innovation environments all guidelines may not be relevant for all OIEs. Therefore, we present these guidelines as general and flexible, to be used as a checklist as shown from the Fig. 3. The form can be used to support design and evaluation of open innovation environments.

In this paper we also analyzed the applicability of UX heuristics in an open innovation environment context. The analysis indicated that all UX heuristics are applicable and it is important to take them into account in the facilitation of an OIE. The heuristics focus on users' experiences, which is an important part of the open innovation environments and user involvement. However, the analysis revealed that design and evaluation of open innovation environments requires a broader approach. For instance, organizational point of views need to be considered, for instance, resources, facilities, business and operational models, among others. Therefore, a need for guidelines for facilitating the whole versatile open innovation environment is justified. Well-working open innovation process and practices will have an immediate influence on all stakeholders.

VII. CONCLUSION

This paper presented guidelines for facilitating user-centric product and service development in an open innovation environment. The aim of the guidelines is to help develop, evaluate and improve open innovation environments and practices e.g. in a living lab. These guidelines are based on the empirical experiences and lessons learned from various case studies conducted in an open innovation environment 2011-2018 [32]. These guidelines support the adoption of open innovation and living lab approach as a natural and continuous practice in different product and service development activities.

We believe that this set of generic guidelines is valuable to take into account in all kind of open innovation environments that aim to involve users in different stages of the product and service development. Processes and practices of open innovation environments should be smooth and effective to make an OIE successful. Therefore, it is important to deploy

these guidelines and evaluate their applicability for example by conducting expert evaluations or analyzing different open innovation environment functions via them. Thus, we regard it as significant to share these guidelines with open innovation professionals and we encourage researchers and practitioners to utilize these guidelines in their open innovation environments.

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