Article

How Firms Can Get Ideas from Users for Sustainable Business Innovation

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Abstract: The importance of user information and user participation for seeking business opportunities has been widely acknowledged in a variety of industries. Therefore, this study aims to suggest a typology for user innovation models as a strategy for sustainable development and to investigate the characteristics of different types user innovation to encourage and support improved utilization of user innovation in firms. For this purpose, we began by collecting 435 relevant papers from the most-cited academic journals. Then, we developed a typology of user innovation models, which consist of four types including workshop-based, consortium-based, crowdsourcing-based and platform-based, and we investigated the characteristics of the suggested types in terms of applications and research trends. The analysis results reveal that each type has different characteristics and that there exist some research gaps in the user innovation field. Our results are expected to foster understanding of user innovation for guiding sustainable business development and provide useful information for both researchers and innovation mangers.

1. Introduction

The technological environment has changed rapidly in the past decade, and technological convergence has occurred across a diverse range of technologies. These changes have prompted companies to seek out and cooperate with external partners, such as government officials, research organizations and other firms in order to strengthen their capabilities and have increased the necessity for firms to engage in strategic planning in order to survive in the market. Paying attention to customers' diverse requirements for new products and services has become one of the essential factors for firms' survival, highlighting the user as a firm's principal external partner for developing sustainable business models. Corporate sustainability can be defined as meeting the needs of a firm's stakeholders such as employees, customers and communities [1], by transposing the idea of sustainable development to the firm level [2]. Considering that users are one of the most significant stakeholders, firms need to understand users' needs accurately and reflect these needs within their innovation processes for developing sustainable business models. Thus, it has been critical for a firm to incorporate users' needs, ideas and feedbacks in innovation for its sustainable growth.

For decades, firms have investigated user behaviors [3,4], and users have been recognized as a source of innovation [5–7], suggesting innovative ideas or creating prototypes of innovative products that organizations can utilize in their new product development (NPD) processes and develop new business models [8,9]. A great deal of relevant research has been conducted on diverse cases of user innovation in practice. Earlier studies focused on the analysis of users' role in innovation [9–13], a comparison of user innovation with supplier-driven innovation [14], and an

exploration of a suitable form of governance for user innovation [15]. Similarly, recent studies have dealt with topics such as the analysis of users' roles as innovators in specific industries [16,17] and interactions between users and manufacturers [18]. At the same time, changes in user innovation have been significantly discussed in previous studies by analyzing interactions among users [19–21] and providing suggestions for the ways in which firms can utilize user communities and crowd sourcing [22–24] for innovation.

Although these studies have examined aspects of user innovation and helped to establish relevant theories, there is a need for further studies. First, most of the empirical research has focused on one or a few cases of user innovation in specific industries. There exist many different types of user innovation in the various industries. Thus, it is essential to investigate the characteristics of each type in order to fully understand user innovation as an approach to designing sustainable business models.

Second, although much research has suggested types of user innovation, most of them were user-initiated cases. As reported by existing studies, there exist a lot of user innovation cases that were initiated by firms. Moreover, business model innovation is more closely related to firm-initiated cases rather than user-initiate cases. In diverse industries, firms have tried to collect user information, knowledge and ideas to seek solutions to problems or to create innovation and business opportunities. Thus, it is time to suggest types of user innovation from the firm perspective to support and foster user innovation in firms.

Third, there is a lack of studies on the overall research trends in user innovation. User innovation has spread widely to industries, and various types of user innovation have been suggested over time. A clear understanding of its evolution is a prerequisite for the better utilization of user innovation in practice. Although past research can enhance our understanding of user innovation, it is not easy to understand the changes in user innovation. To address this issue, it would be meaningful to investigate past and emerging user innovation models by analyzing patterns in user innovation research.

Therefore, this study aims to suggest a typology of user innovation models and investigate them to encourage and support the better utilization of user innovation in firms as a method to find sustainable business opportunities. For this purpose, first, we collected publications on user innovation from the top 25 most-cited journals in the technology and innovation management area. Second, we identified the user innovation context by developing an analysis strategy and a typology of user innovation models. Third, we derived four types of user innovation models according to a typology, and investigated the characteristics of each type in terms of the context of applications, research trends and sustainable business models. Finally, we tried to find implications and research gaps in the user innovation field in order to propose future research directions, especially for the purpose of business model innovation for sustainability. The research findings are expected to enhance the understanding of user innovation and help in the utilization of user innovation in firms for their sustainable growth.

The rest of the paper is organized as follows: In Section 2, we review existing studies of user innovation and sustainable business models. In Section 3, we explain the overall research process and the detailed processes of this study. We describe the data collection process in Section 4 and discuss the typology of user innovation models in Section 5. In Section 6, we investigate the characteristics of each type of user innovation model based on the data. In Section 7, the implications, research gaps and future research directions are explained. Finally, in Section 6, we present the contributions and limitations of the current study.

2. Background

This study proposes a typology of user innovation models and investigates the characteristics of the various types. To this end, we must first define the concept of user innovation models and the criteria of a typology. Therefore, this section reviews the literature on innovation models, which can provide a basis for defining user innovation models.

2.1. User Innovation Models

An innovation model is a framework for understanding the relationship between technology, science, and economics [25]. Based on the relationship, types of innovation models are defined. For example, Rothwell [26] suggested five generations of innovation process models. Chesbrough [27] suggested the concept of an open innovation model. In this model, internal R & D using external resources that were acquired through cooperation with external partners is crucial. User innovation is similar to the open innovation model in that the sharing of knowledge and information by interactions and co-operation between actors plays an important role in innovation. Meanwhile, it is different from the open innovation model in that its main actors consist of *users, firms*, or *facilitating organizations (intermediary firms, NGOs, universities, research funding agencies and governmental agencies)*. Further, interactions and co-operation between users or user and firm are the principal sources of innovative ideas. To better use open innovation, firms should not only adopt information and knowledge from external partners, but also freely reveal their own information and knowledge to the public. However, openness generally conflicts with firms' need to protect their intellectual property [28]. User innovation overcomes these limitations of open innovation and, therefore, has received much interest from both industry and academia. However, it is not easy to define a "single" general user innovation model because the characteristics of user innovation differ in each case of user innovation. Therefore, this research examines cases of user innovation from past studies and suggests a typology of user innovation models.

Most relevant research in user innovation has been conducted on actual cases, and such research has yielded insights into several aspects of user innovation. Among them, how innovation outputs are used and for whom are one of the most significant factors to define types of user innovations, considering that the ultimate goal of innovation is to create value for the company, the users, and the deliverable itself. In this vein, user innovation types can be grouped into three categories by innovation initiators—user-initiated innovation, firm-initiated innovation, and intermediary-initiated innovation.

The existing literature tended to focus on user-initiated innovation. A representative case is that of the user-innovator [29,30]. Though innovation outputs acquired through user innovation are objects of commercialization, they can be a means to satisfy users' needs. User-innovators develop their ideas to fulfill their own needs [31–34], and share and diffuse their resulting innovations freely to other users [29]. In several industries, such as rodeo kayaks [35,36], kite surfing equipment [30], motorcycles [37], computer games [38] and sports-related consumer products [29], user-innovators developed a novel product and launched it to the market. In these cases, user-innovators became user manufacturers who led the overall innovation processes from idea generation to commercialization.

However, as new types of user innovation tools such as crowdsourcing, open-source software, and a user toolkit have been suggested to assist firms in idea gathering from users, firm-initiated user innovation has started to prevail in diverse industries. A lot of firms in software industries prefer to use open source software as a platform to grab users' ideas [39–41]. User toolkits have been used to make users self-design their own product, and firms adopt users' ideas to develop new products or services in computer game [42], ski [43], and watch industries [44].

Recently, cases of user innovation led by facilitating organizations such as intermediary firms, NGOs, universities, research funding agencies, and governmental agencies have been reported. In these cases, intermediary firms facilitate the bringing together of users and firms to make innovative products. InnoCentive [45], TopCoder [46], and direct firm solicitation of innovation by Procter and Gamble [47] are good examples.

Since the concept of user innovation has come to prominence, diverse types of user innovation initiated by different actors have been reported. Thus, these types should be considered in the process of developing a typology of user innovation models. Among the three types, we restrict our focus to the second type, which is worth investigating because more firms are required to innovate their product and service offerings in collaboration with potential users in the era of open innovation.

2.2. User Innovation for Designing Sustainable Business Models

With global development and as associated resource use has been accelerated, it seems apparent that business as usual is not an option for a sustainable future [48]. Firms have to create value by seizing business opportunities, deliver an economic value to customers, and provide ecological and/or social value to the public for their continuous growth. Emphasizing the importance of business as a driver of innovation, previous studies suggested that a business model is a useful framework for corporate innovation [49–51], and business model innovation is a key to success of firms [52,53]. However, long-run sustainability needs clear understanding about economic, environmental and social factors of sustainability [54] and may require radical, fundamental and difficult changes in corporate business models [55].

The business model is the rationale of how an organization creates, delivers, and captures value and can be described through nine building blocks: (1) customer segments; (2) value proposition; (3) channels; (4) customer relationships; (5) revenue streams; (6) key resources; (7) key activities; (8) partner network; and (9) cost structure [56]. In particular, a "sustainable" business model is defined as a business model that creates competitive advantage through superior customer value as well as contributes to sustainable development of the company and society [52]. To build a sustainable business model, firms have to transform their business models towards creating positive impacts or reduce negative impacts for the environment and society. This business model innovation for sustainability is realized by changing the way of firms' value network creation, value capture and delivery, and value proposition [48]. Hence, firms have to generate new sources of profit by finding novel value proposition and value constellation combinations for developing sustainable business models [57].

Users, as major customers, can be valuable sources in developing sustainable business models. Stubbs and Cocklin [50] asserted that sustainable business models must develop internal structural and cultural capabilities to achieve firm-level sustainability and collaborate with key stakeholders to achieve sustainability for the system that a firm is part of. Here, one of the major stakeholders is users. They reveal who the key customers are and what values they want to have. In addition, they are willing to develop and even offer their own innovation ideas to firms. In a similar vein, Osterwalder and Pigneur [56] also emphasized the significance of users for business model development by arguing that customer segments, customer relationships and channels should be aligned, considering potential trade-offs, to conceptualize an effective business model. By adopting user innovation that consists of user-own information and knowledge, therefore, firms can generate a novel value proposition, leading to sustainable business model innovation. Here, it should be noted that business model innovation is not just changing the product and service offerings for the customer. It involves changing "the way of business", rather than "what firms do" and must go beyond process and products [58].

Accordingly, business model innovation for sustainability should be pursued from the perspective of sociotechnical systems, not in terms of the technical system. Quite naturally, the role of users as sources of innovative ideas for sustainable business models should also be analyzed within the framework of sociotechnical systems. For example, in the case of living labs, users shape the innovation in their own real-life environments, unlike the traditional approaches to users where the insights of users were captured and interpreted by experts [59]. Innovation occurs in value network constellations and users play a significant role. This notion indicates that it is worth investigating the role of users in the process of business model innovation, which is expected to help facilitate the adoption of user innovation models by firms for designing sustainable business models.

3. Overall Research Processes

The overall research process of this study is shown in Figure 1. First, we collected relevant papers on user innovation from online academic journals. Second, we identified a user innovation context based on collected papers. Here, we adopted the 5W1H (*i.e.,* who, when, where, what, why,

how) method to develop an analysis strategy and a typology of user innovation models. Third, we investigated user innovation types. The context of applications and the research trends of each type were analyzed. At last, we derived implications and future research trends based on the analysis results.
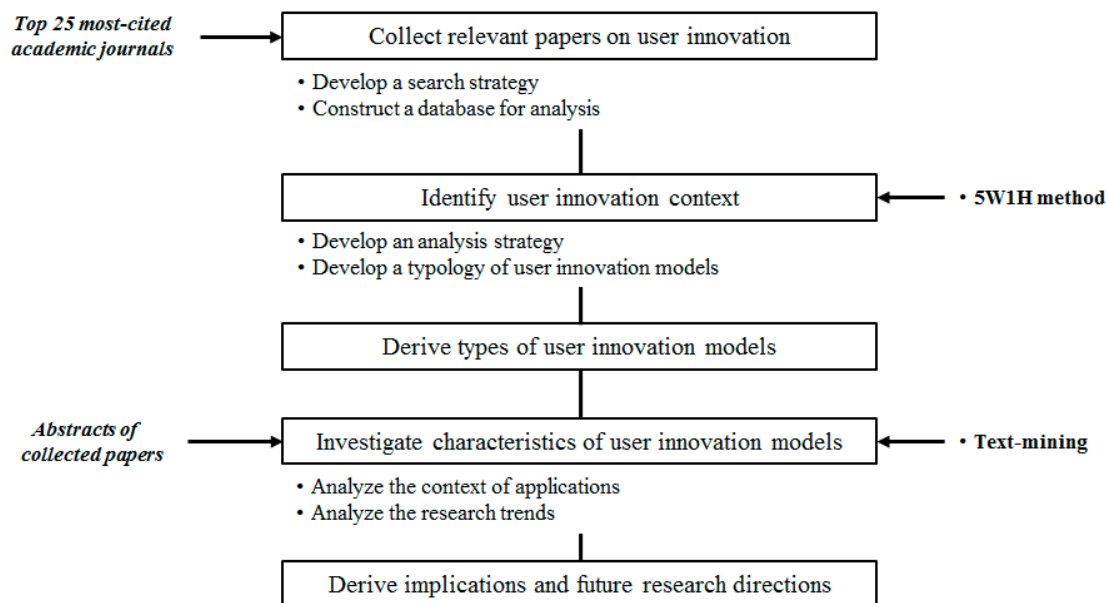

Figure 1. Overall research process.

3.1. Step 1: Collect Data for Analysis

3.1.1. Develop a Search Strategy

We collected papers published between 1976 and 2015 from the top 25 most-cited technology and innovation management journals that were mentioned in past studies [60,61]. We used "user innovation" and "user-innovation" as the initial search keywords. All of the publications that include the term "user innovation" or "user-innovation" in the title, abstract, or keywords were collected. The initial keywords were too simple in order to search for sufficient amounts of relevant publications, so we tried to analyze the author keywords of collected publications to extend the search terms. Keywords which have been used more frequently than others were selected; then, among them, meaningful keywords in the user innovation context were chosen to extend the search keywords set (see Table 1). The extended keyword set includes "open source software", "user community", "co-creation", "crowdsourcing", "user design", "self design", "user toolkit" and "lead user". These are the top eight keywords most frequently appearing as keywords in the papers obtained by our initial search.

Table 1. Extended keywords set.

Keywords	Number of Publications	Search Term
Open source software	4	"open source software", "open-source software"
User community	8	"user community", "user-community"
User toolkit	6	"user toolkit", "user-toolkit"
Lead user	3	"lead user", "lead-user"
Co-creation	2	"cocreation", "co-creation"
Crowdsourcing	2	"crowdsourcing", "crowd-sourcing"
User design	2	"user design", "user-design"
Self design	2	"self design", "self-design"

3.1.2. Construct a Database for Analysis

The collected publications were screened to construct a database for analysis. In order to identify the user innovation context, publications that described a theoretical approach without a concrete mention of user innovation cases or processes were excluded.

3.2. Step 2: Identify User Innovation Context

3.2.1. Develop an Analysis Strategy

To identify the user innovation context, we first developed an analysis strategy by adopting the 5W1H method, and the results of using this method to find out how firms get ideas from users are presented in Table 2.

Table 2. 5W1H: how firms get ideas from users.

5W1H	How Firms Get Ideas from Users
Who	Types of users
Where	Types of industries
What	Innovation ideas—types of problems
When	Firms' innovation processes
Why	Firms' purposes of getting information
How	Types of tools firms utilize to get information from users

3.2.2. Develop a Typology of User Innovation Models

According to the types of initiators—user, firm, and facilitating organizations—user innovation models can be distinguished. Hence, a typology of user innovation models has to cover those diverse types. However, because the current study investigates user innovation from the firm perspective, the suggested typology just covers firm-initiated user innovation models. We regarded the motivation of firms initiating innovation as the most important aspect of firm-initiated user innovation. They correspond to "what" and "why" in Table 1. Thus, we defined the "purpose of getting ideas" ("why" firms start to get ideas) and the "types of problems" ("what" problems are they dealing with) as the criteria of a typology. Accordingly four type of innovation models can be identified from a two-by-two matrix. We also attempted to assign types of tools ("how" firms get ideas from users) to each type of user innovation model, which is also significant for firms in order to implement user-driven innovation.

3.3. Step 3: Investigate Types of User Innovation Models

The four types of suggested user innovation models were analyzed in terms of the context of applications and the research trends. The analysis results provide information about "who," "where," and "how" in the user innovation context. The criteria "when" was removed from our analysis because relatively little information about when user ideas were utilized during the innovation process was provided in the papers. In addition, innovation processes are so diverse across firms that it is infeasible to define a standard innovation process, which is a preliminary procedure for our analysis.

3.3.1. Analyze the Context of Applications

To investigate "who," "where," and "how" in the user innovation context, the kinds of users, industry, and tools in each type were analyzed. Particularly, the industry is worth investigating because user innovation may not be appropriate for all industries. Many researchers regarded users as product developers who contribute to innovation [9] in the semiconductor [12], scientific instrument [7], and machine tool industries [11]. However, different industries many need different

types of user innovation models. For the analysis, we adopted the International Standard Industrial Classification (ISIC) to clearly distinguish the types of industry and we standardized the types of users based on the existing studies (see Table 3).

Table 3. Types of users.

Types of Users	Definitions
General users	Individuals or groups who use or may use a product/service from a target firm
Expert users	Users who own technical skills and knowledge
Lead users	Users who experienced needs still unknown to general users
Innovative users	Users who self-developed an innovation for their own needs
User community	A group of users

3.3.2. Analyze the Research Trends

To investigate the research trends for each type of user innovation model, the annual number of publications was analyzed and the keywords that were frequently used in pairs were extracted from abstracts of publications. To extract keywords, a text-mining tool, TextAnalyst, was used.

4. Data Collection

As a result of the initial search, 140 publications were collected. By investigating the author keywords of 140 collected publications, an extended keywords set that consists of eight terms was defined as shown in Table 3. Using the extended keywords set, an additional 295 publications were collected.

Consequently, a total of 435 publications were collected from 25 journals. The annual number of publications from 1976–2015 was stable at one to two before 2000, but it has rapidly increased since then (See Figure 2). We screened 435 collected papers to construct a database for analysis. After the screening, 149 publications on user innovation were chosen for our analysis (see Appendix 1).
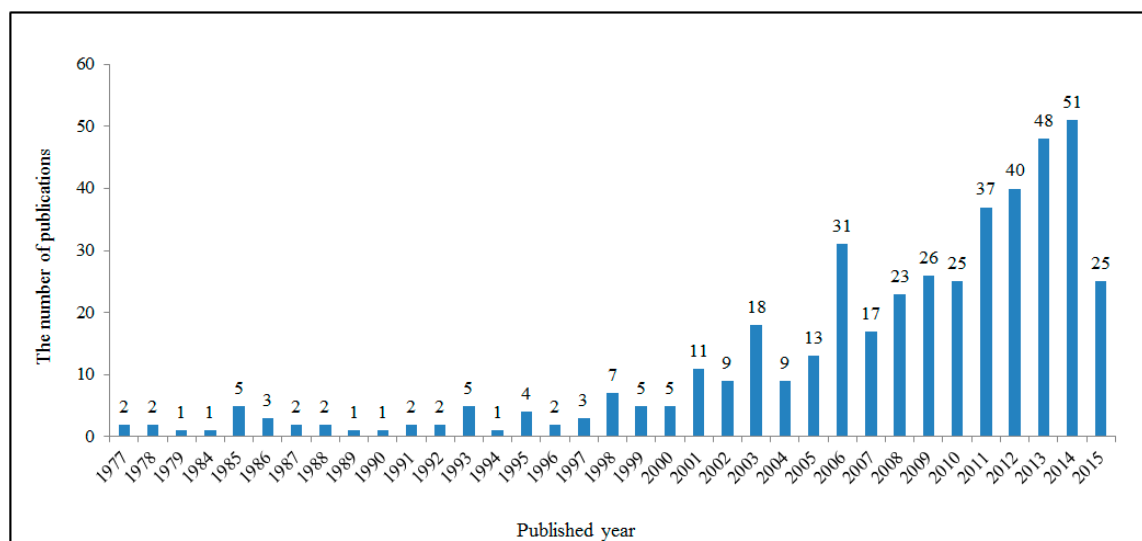

Figure 2. The annual number of collected publications (1976–July 2015).

5. Types of User Innovation Models

To derive the types of user innovation models, we first define the levels of the criteria. Firms may utilize users' innovation ideas to seek solutions for problems or to co-create innovation with users based on user-own information or knowledge.

Hence, the first criterion, "purpose of getting ideas," consists of two levels: idea adoption and idea co-creation. In the former case, interactions between firms and users are likely to be one-directional; users transfer their innovation ideas to a firm while firms try to capture ideas from users. Whereas, in the latter case, relationships between firms and users are interactional; discussions and feedback may be developed between firms and users to co-create innovation ideas. User–firm interactions and user–user interactions have been recognized as factors affecting innovation performance [6]. Particularly, it was discovered that user–firm interactions reduce the uncertainty of innovation, and this is linked to the successful commercialization of new products or services [18]. As was mentioned above, there are two types of user–firm interactions: one-directional, such as innovation contests [62,63], and interactional, such as direct user involvement in a firm's innovation process [64–66]. The interaction can also happen between users. User–user interactions enable the diffusion of knowledge, information, and experience that individual users own, and encourage user innovation [67]. However, as the focus of this study is firm-initiated user innovation, only the user–firm interactions are considered for further analysis.

The second criterion, "types of problems," consists of two levels: a given problem and an open problem. Firms may adopt user ideas to solve a pre-defined problem, for example, finding a way to improve a particular function of their products/services, which is the former case. Actually, lead users own much of the solution knowledge about specific problems, and thus, they frequently play a key role in the creation of knowledge [68]. On the other hand, firms may utilize user ideas to handle an open-ended problem, for example, exploring all possible ways to improve their existing product/services. These are the two most critical factors that will affect the way firms adopt user innovation.

According to the criteria of a typology, four types of firm-initiated user innovation models are derived (see Figure 3). We named the four types that were derived by considering the available types of tools for getting ideas, information, and knowledge for each type, focusing on the most frequently used ones.
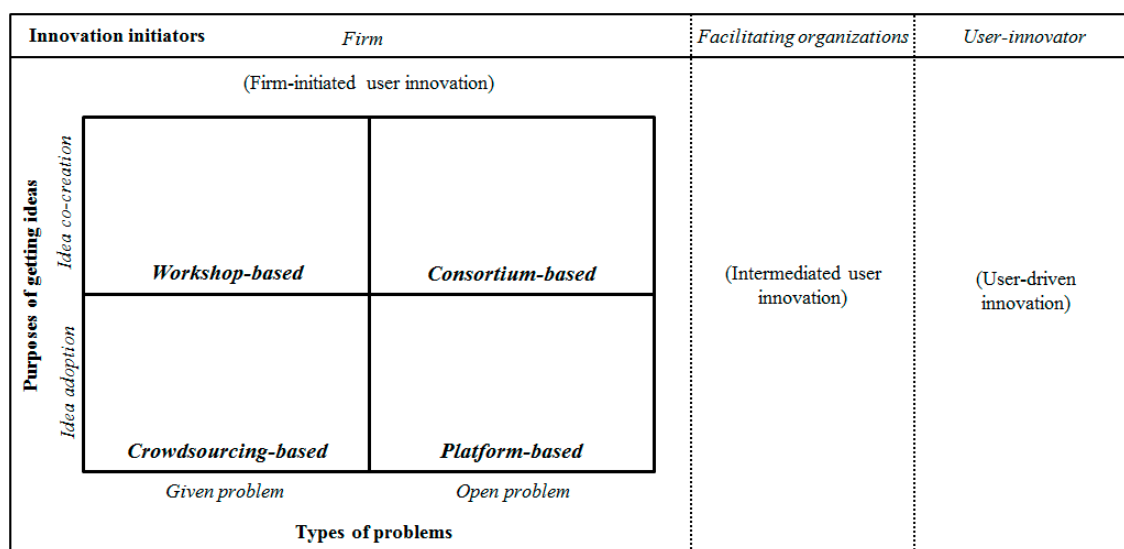
Figure 3. Four types of user innovation models.

At first, in the case of type 1, firms can organize user-involved workshops to seek solutions for problems by cooperating with users. Thus, the name "*workshop-based*" was given to this type. Second, in the case of type 2, firms generally co-work with users who possess technical knowledge, such as experts, technicians and professional users to determine some problems and to co-create novel innovation. Hence, the name "*consortium-based*" was assigned to this type. Third, when firms

want to seek solutions for given problems, they tend to crowdsource innovation ideas by using idea competition or contest. Thus, this type was named "*crowdsourcing-based*". At last, in the case of type 4, firms are likely to develop online or offline platforms that are open to users for the purpose of problem-seeking. This case was called "*platform-based*".

After the designation, we assigned 149 publications to each type. The result is shown in Table 4. Among 149 publications, 57 were assigned to the "*platform-based*" category, 36 to the "*workshop-based*" type, 21 to the "*crowdsourcing-based*" format, and seven to the "*consortium-based*" type. The other 28 publications were not assigned to any of the four types because they addressed user innovation cases in which the innovation initiators were not firms.

Table 4. The number of assigned publications to each type of user innovation models.

Types of User Innovation Models	The Number of Publications
Workshop-based	36
Consortium-based	7
Crowdsourcing-based	21
Platform-based	57
Others	28
Total	149

6. Characteristics of User Innovation Models

6.1. The Context of Applications

The analysis results of the context of applications for each type of user innovation model are as follows.

Firstly, the results for the "*workshop-based*" type are shown in Table 5. In this type, firms generally got ideas from general or lead users; the workshop, lead user method, user research interviews, surveys, and group research are the main types of tools. This type has occurred in diverse sectors such as the manufacturing, information and communication, and many service industries. The results mean that because this type utilizes relatively basic and traditional tools, it has widely spread to a diverse range of industries. The firms in this type must determine solutions based on user-owned information and knowledge; thus, they seem to prefer selected users to large groups of people, such as the user community, for their purposes. Figure 4 depicts the model for this type.

Next, the results for the "*consortium-based*" type are shown in Table 6. In this type, firms generally got ideas from expert users via collaboration. Firms in professional, scientific, and technical activities industries prefer this type. The purpose of a consortium is to explore ideas to find out potential problems and solutions for them. Thus, expert users who possess technical knowledge and skills seem to be preferred. Figure 5 depicts the model of this type.

The results for the "*crowdsourcing-based*" type are shown in Table 7. In this type, general users and the user community are the main types of users and crowdsourcing and idea competition are primarily used as tools for getting ideas. Firms in manufacturing, such as the computer, automotive, and information and communication industries, prefer this type. In this type, crowdsourcing or idea competition for the design of products (e.g., the design of sporting goods, jewellery, and baby products) are frequently used as the main tools. Thus, general users or the user community are preferred. However, some cases of idea competition which focused on a lead or expert users also appeared. Figure 6 depicts the model of this type.

Table 5. Characteristics of types of user innovation models: workshop-based.

	The Number of Cases
Types of users	
General users	18 (45.0%)
Lead users	16 (40.0%)
Expert users	2 (5.0%)
Innovative users	-
User community	-
Types of industry	
Manufacturing	21 (52.5%)
Information and communication	7 (17.5%)
Professional, scientific, and technical activities	4 (10.0%)
Financial and insurance activities	2 (5.0%)
Wholesale and retail trade	1 (2.5%)
Administrative and support service activities	1 (2.5%)
Types of tools	
Workshop (customer participation, user involvement)	11 (27.5%)
Others (repertory grid, skepticism-identification, casemap)	11 (27.5%)
Lead user method	9 (17.5%)
User research (interview, survey, group research)	4 (10.0%)
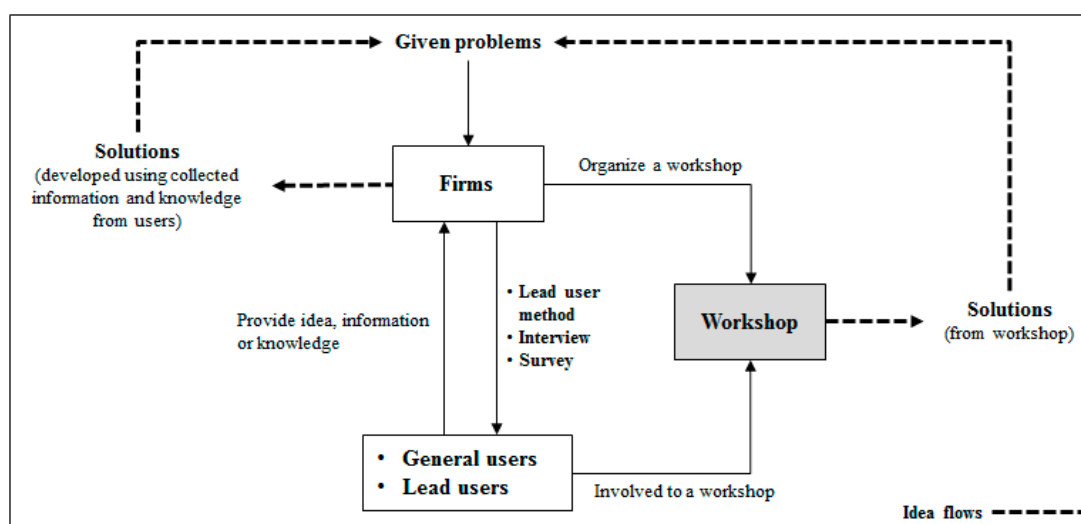
Figure 4. Innovation model: "workshop-based" type.

Table 6. Characteristics of types of user innovation models: consortium-based.

	The Number of Cases
Types of users	
Expert users	5 (75.4%)
Lead users	1 (14.3%)
General users	1 (14.3%)
Innovative users	-
User community	-
Types of industry	
Professional, scientific, and technical activities	4 (57.1%)
Information and communication	2 (28.6%)
Manufacturing	1 (14.3%)
Types of tools	
Collaboration (co-development, co-invention)	5 (83.3%)
Living lab	1 (16.7%)
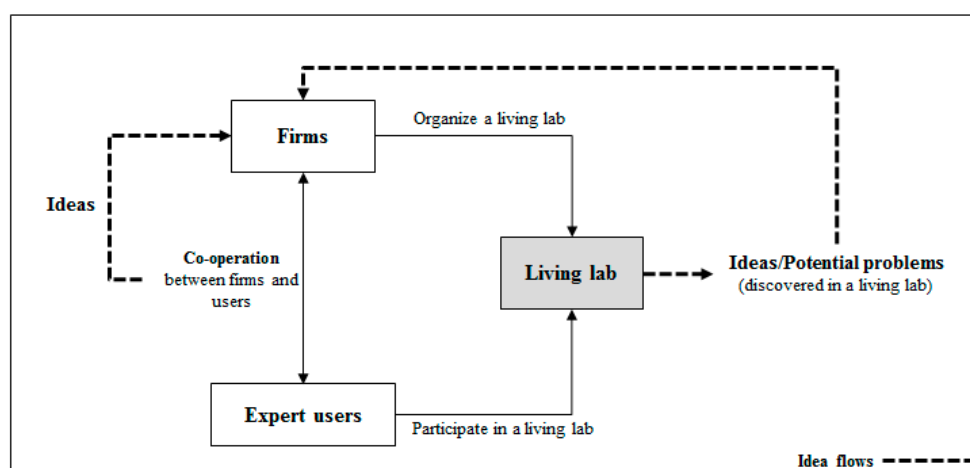
Figure 5. Innovation model: "consortium-based" type.

Table 7. Characteristics of types of user innovation models: crowdsourcing-based.

	The Number of Cases
Types of users	
General users	11 (50.0%)
User community	6 (27.3%)
Innovative users	2 (9.1%)
Lead users	1 (4.5%)
Expert users	1 (4.5%)
Types of industry	
Manufacturing	13 (59.1%)
Information and communication	6 (27.3%)
Financial and insurance activities	1 (4.5%)
Construction	1 (4.5%)
Types of tools	
Crowdsourcing	9 (83.3%)
Competitions (idea contest, idea competition)	8 (16.7%)
Open platform	1 (4.5%)
Lead user method	1 (4.5%)

Figure 6. Innovation model: "crowdsourcing-based" type.

At last, the results for the "*platform-based*" type are shown in Table 8. In this type, firms generally acquire ideas from general users and the user community by using an open platform, such as an open-source software and online community or user toolkits. Thus, firms in the software industry that use open-source software and manufacturing firms that provide users with toolkits both prefer this type. Figure 7 depicts the model of this type.
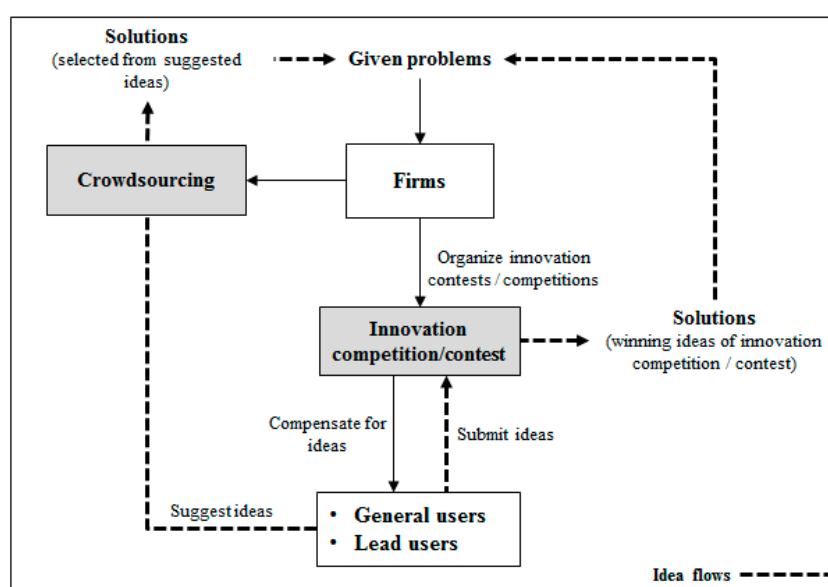
Table 8. Characteristics of types of user innovation models: platform-based.

	The Number of Cases
Types of users	
User community	21 (37.5%)
General users	20 (35.7%)
Expert users	7 (12.5%)
Innovative users	5 (8.9%)
lead users	4 (7.1%)
Types of industry	
Information and communication	30 (53.6%)
Manufacturing	24 (42.9%)
Professional, scientific, and technical activities	3 (5.4%)
Human health and social work activities	1 (1.8%)
Types of tools	
Open platform (open source software)	24 (42.9%)
User toolkit	13 (23.2%)
Online community	10 (17.9%)
Virtual worlds	3 (5.4%)
Crowdsourcing	2 (3.6%)
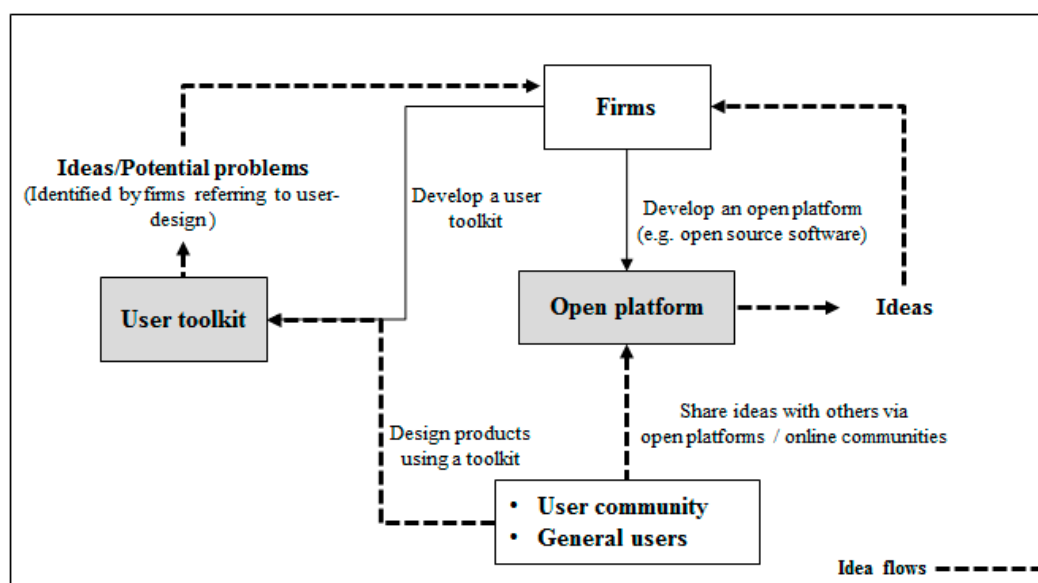
Figure 7. Innovation model: "platform-based" type.

6.2. The Research Trends

The research trends for the types of user innovation models are as follows: First, the trends of publications for the four types are shown in Table 9. The number of publications in the "*workshop-based*" type has consistently increased since 1986. Since this type is relatively traditional, relevant research seems to be published earlier than other types. The number of publications in the "platform-based" type has rapidly increased since 2003. This may be affected by the special issue on open-source software that was published in 2003 (*Research Policy*) and 2006 (*Management Science*). The

number of publications in the "*crowdsourcing-based*" type shows increasing trends since 2010, which means that crowdsourcing is one of the recent hot topics within the user innovation field. The top five papers with the largest number of citations in each type are listed in Appendix 2.

Table 9. The research trends: the number of publications.

Year	Workshop-Based	Consortium-Based	Crowdsourcing-Based	Platform-Based
1977				
1985		1		
1986	1			
1988	1			
1993			1	
1999	1			
2000				
2001	1			1
2002	1		1	1
2003	2			7
2004	3			1
2005				4
2006		1	1	7
2007	1			1
2008	3		1	4
2009	4	1		4
2010	1		1	2
2011	1		4	3
2012	6		4	3
2013	6	1	3	6
2014	6	2	4	9
2015	2	1	2	3

Next, the keywords for the four types that we extracted are shown in Table 10. In the "*workshop-based*" type, judging from pairs of keywords such as "product-user," "user-idea," and "user-knowledge," we can infer that firms in this type usually get ideas or knowledge from people who use their products. In the "*consortium-based*" type, pairs of keywords such as "collaborative-prototyping," "problem-prototyping," and "user-collaboration" show that the main characteristics of this type is a collaboration of firms and users to derive some prototypes. In the "*crowdsourcing-based*" type, pairs of keywords such as "user-crowdsourcing," "idea-crowdsourcing," and "user-competition" show the main types of tools in this type. In the "*platform-based*" type, "user-community," "user-toolkit," "software-community," and "source-software" indicate the frequently used tools and the main kinds of users of this type. A time-series analysis was also conducted but it offered few meaningful implications, indicating that the research focus has remained largely the same in each category when judged by keywords.

Table 10. The research trends: a pair of keywords in abstracts.

Workshop-Based	Consortium-Based	Crowdsourcing-Based	Platform-Based
Product-development	Product-innovation	Idea-competition	User-community
Product-user	Collaborative-prototyping	Idea-generation	(Open)Source-software
(lead) user-method	Product-user	User-idea	User-product
User-idea	Problem-prototyping	Product-idea	User-toolkit
User-development	User-collaboration	User-crowdsourcing	Product-community
Product-idea		Idea-crowdsourcing	Innovation-community
Product-concept		User-competition	Software-community
User-knowledge			User-development
Professional-user			
Expert-user			
Product-development			

6.3. Consortium-Based User Innovation for Sustainable Business Models

For designing sustainable business models, one of the key challenges is to enable a firm to gain economic value for itself through delivering social and environmental benefits [69]. In addition, many researchers argue that considering social practices is of importance for making changes to existing routines and lifestyles to more appropriate ones for sustainability purposes [70–72]. A consortium-based innovation can be one of the ways to tackle these challenges by taking a sociotechnical approach to developing sustainable business models.

Living labs are an emerging and representative approach to consortium-based user innovation. Being characterized by openness and user involvement, this approach requires firms to consider ideas stemming from external sources in the innovation processes, particularly those from users [73]. It stresses the central role of the user and users are active participants. Thus, the living labs approach is regarded as a method of innovation, a collection of open innovation tools and networks, experimentation platforms, and a tool for user involvement from the sociotechnical perspective. For example, Liedtke *et al.* [74] introduce the sustainable living lab research infrastructure as an example of a setting for socio-technical experiments in product-service-systems. Other researchers have focused on living labs as a tool for research and governance [75,76], for solving social problems [77], or for social innovation [78].

In our analysis, the living lab was used as a tool for user innovation in a "*consortium-based*" type (see Table 6). However, there are few papers having both keywords "user innovation" and "Living lab(s)" in the top 25 most-cited innovation journals, possibly because the living lab research is building its own research streams. Actually, we could find more living lab papers published in other journals than our target innovation journals. About 303 publications are retrieved by searching on GoogleScholar using "living lab" and "user innovation" as searching keywords. These studies were conducted to suggest a framework to fertilize user innovation by using a living lab [79,80], explore user innovation in living labs [81], seek out affecting factors of user participation in living lab field trials [82], and explore differences between several test methods for user involvement in a living lab context [83]. User innovation studies, adopting a living lab approach, have been conducted sporadically. Investigating these studies in detail will provide meaningful implications for developing sustainable business models.

7. Implications and Future Research Directions

Several implications that can be derived from the analysis and future research possibilities are discussed here. First, the number of studies about the "*consortium-based*" type is relatively small. Recently, research about living lab, a representative approach for a "*consortium-based*" type, has been actively conducted in practice and academia. Seeking new innovation ideas in a consortium enables to change a firm's business models from the perspective of industrial eco-systems and not within the firm. Therefore, it may be valuable to study the "*consortium-based*" type in the future; for instance, how a living lab approach can be utilized to facilitate user innovation in the context of innovation studies. Among 149 publications on user innovation (see Appendix 1), we could find only one relevant paper, which uses the keyword "living lab" in its abstract. Though most of the living lab research is expected to be published in other journals, more discussions would be needed in the innovation journals.

Second, the user community has hardly been utilized for idea co-creation; however, it has widely been utilized for idea adoption. It is possible that the user community possesses plenty of useful information and knowledge for the development of products, technology and service if it is comprised of lead or expert users. Thus, if firms establish a workshop or a consortium with a user community, then there exists a possibility that firms can get useful ideas for new business development. Therefore, it is worthwhile to study a potentiality of the user community as a cooperation partner for idea adoption in firms.

Third, service firms have seldom utilized crowdsourcing or an open platform. In a "*workshop-based*" type, firms in service industries (e.g., the financial, insurance, and mobile telephone

sectors) have held workshops to obtain ideas from users. In contrast to the "*workshop-based*" type, in the "*crowdsourcing-based*" and "*platform-based*" types, just a few firms in service industries have adopted ideas from users. Service quality is influenced by firm–user interactions, meaning that user innovation is significant for sustainable business development not only in manufacturing fields but also service fields. Hence, the way in which firms adopted users' ideas to seek out solutions or problems can be a valuable research subject in future studies.

Finally, there exists a lack of studies on the intermediated user innovation, though we restricted our focus to firm-initiated user innovation. Most of the existing studies tended to link user innovator roles mainly to organizational tasks by restricting their focus to innovation processes taking place inside the firm. However, the recent trend towards openness brings about new inter actor tasks between the organizations and individuals participating in open innovation, where the role of the intermediary to facilitate or manage these emerging tasks would emphasized. Of course, we could find a few user innovation cases led by intermediaries that support cooperation between firms and users but relevant research has hardly been conducted. Intermediated user innovation led by intermediaries can be a good alternative for firm-initiated or user-led innovation, and the characteristics of this type of user innovation may be valuable to analyze. That is, using an intermediary can be another option for seeking new business ideas. Therefore, in future studies, research on the intermediaries of user innovation must be conducted.

8. Conclusions

Users can be a valuable source for new business development. This study aims to suggest a typology of user innovation models that can encourage and support utilization of user innovation for seeking new business opportunities and further designing sustainable business models based on the opportunities. We retrieved relevant papers from the 25 most-cited journals in the technology and innovation management field and adopted a 5W1H method to develop an analysis strategy and a typology of user innovation models. Four types of user innovation models were derived according to a suggested typology, and the characteristics of each type of user innovation model were investigated in terms of applications and research trends. As a result of the study, we found that each type of user innovation model prevailed in different industries, and firms of each type utilized different tools to adopt ideas, information and knowledge from various kinds of users. We determined that there are some research gaps and suggest future research directions to achieve user innovation for sustainable business growth.

This study contributes to future research in two ways: First, our results on a typology of user innovation model and analysis results for each type can provide useful information to the decision makers of firms that want to get ideas from users for their new business development. For example, firms that want to get ideas from users in specific industries can acquire information about which types of users and tools are suitable for their purposes. Second, we identified gaps on user innovation research and suggest directions for future study. Although there exist many studies on user innovation, research on trends of user innovation has not been conducted. The results of research trends enhance our understanding of user innovation studies and future research directions can encourage further studies on user innovation as a meaningful approach to business innovation.

Although this study has made meaningful contributions, it also has some limitations. First, it only focuses on firm-initiated user innovation. Since a proposed typology covers only firm-initiated user innovation, it is not a complete one. In addition, our typology for user innovation models was developed completely according to literature on the assumption that frequently used innovation models are often studied in academia and, thus, may not coincide with the reality of user innovation in the field. Second, more in-depth trends analysis needs to be carried out because this study investigated only the number of papers in each type of user innovation model. However, more meaningful implications can be derived from time-series analysis on types of users, industries, or tools in each type. Finally, there is still room for further improvements in data collection. The data

source for analysis was restricted to the 25 most-cited journals in the technology and innovation management field. However, user innovation is a multi-disciplinary research field, and there may exist relevant papers in other fields. Hence, future research will address these issues.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix

Appendix 1. The List of the Top 25 Most-Cited Journals and the Number of Collected Publications from Each Journal

Journals	The Number of Publications	
	Collected	Analyzed
Academy of Management Journal	5	1
Academy of Management Review	4	1
Administrative Science Quarterly	2	2
American Economic Review		-
California Management Review	13	5
Economic Journal	1	-
Harvard Business Review	16	4
IEEE Transactions on Engineering Management	7	1
Industrial and Corporate Change	7	3
International Journal of Technology Management	16	4
Journal of Marketing	12	7
Journal of Marketing Research	1	-
Journal of Political Economy	-	-
Journal of Product Innovation Management	92	29
Long Range Planning	6	3
Management Science	26	11
MIS Quarterly	24	3
MIT Sloan Management Review	12	4
Organization Science	11	4
R & D Management	52	17
Research Policy	54	28
Research-Technology Management	21	8
Strategic Management Journal	21	1
Technological Forecasting and Social Change	19	6
Technovation	13	7
Total	435	149

Appendix 2. Key Papers in Each Type of User Innovation

Appendix 2.1. Workshop-Based

No	Title	Journals	Citations *
1	Lead users: a source of novel product concepts	Management science	3943
2	Lead user analyses for the development of new industrial products	Management science	1077
3	From experience: Developing new product concepts via the lead user method: a case study in a "low tech" field	Journal of product innovation management	730
4	Creating breakthroughs at 3M	Harvard business review	729
5	Characteristics of innovating users in a consumer goods field: an empirical study of sport-related product consumers	Technovation	464

* The number of citations is based on Google Scholar data.

Appendix 2.2. Consortium-Based

No	Title	Journals	Citations *
1	Users' contributions to radical innovation: evidence from four cases in the field of medical equipment technology	R&D Management	334
2	The role of the interaction between the user and manufacturer in medical equipment innovation	R&D Management	261
3	Community engineering for innovations: the ideas competition as a method to nurture a virtual community for innovations	R&D Management	242
4	Using users: when does external knowledge enhance corporate product innovation?	Strategic Management Journal	26
5	Collaborative prototyping: cross-fertilization of knowledge in prototype-driven problem solving	Journal of product innovation management	9

* The number of citations is based on Google Scholar data.

Appendix 2.3. Crowdsourcing-Based

No	Title	Journals	Citations *
1	Performance assessment of the lead-user idea-generation process for new product development	Management science	788
2	Toolkits for idea competitions: a novel method to integrate users in new product development	R & D Management	545
3	The value of crowdsourcing: can users really compete with professionals in generating new product ideas?	Journal of product innovation management	290
4	Crowdsourcing as solution to distant search	American management review	258
5	Users as service innovators: the case of banking services	Research policy	195

* The number of citations is based on Google Scholar data.

Appendix 2.4. Platform-Based

No	Title	Journals	Citations *
1	Open source software and the "private-collective" innovation model: issues for organization science	Organization science	1756
2	Motivation of software developers in open source projects: an internet-based survey of contributors to the Linux kernel	Research policy	1202
3	Shifting innovation to users via toolkits	Management science	1014
4	Community, joining, and specialization in open source software innovation: a case study	Research policy	844
5	Satisfying heterogeneous user needs via innovation toolkits: the case of Apache security software	Research policy	716

* The number of citations is based on Google Scholar data.

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