



Three Essays on User Innovation: The Implication for Policymakers

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**Three Essays on User Innovation:
The Implication for Policymakers**

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A Macro View of User Innovation:

The Implications for Policymakers

Abstract

The prevalent innovation paradigm has started to shift from the powerful mass production of standardized products by producers to customized production carried out by countless anonymous user innovators. These products' users modify or develop products to satisfy their own needs, but are not amateurs. Existing research finds that innovations created by users can become significant and lead the market. Examples can be found in various products such as software, sports equipment, scientific instruments, and banking services.

However, most user innovation studies are limited to a single or a few case studies in specific product categories. The objective of this thesis is to provide a macro view of user innovation at a national level. This thesis consists of three parts. The first paper provides a general understanding of user innovation at the national level via large-scale national surveys conducted in Japan and the United States. It explores the rate of user innovation, demographic data of user innovators, and users' motives for product development. The second paper further investigates the characteristics of user innovators that influence their adoption of innovation. For this part, an online survey with 21,027 respondents was conducted in Japan. The final paper explores national support for user innovation in practice via a case study of the Danish user-driven innovation program, which is the first national-level attempt to support user innovation. It provides a better insight into the gap between academics' suggestions and the real level of national support offered for user innovation. Based on these findings, the implications for policymakers such as barriers and suitable measures in supporting user innovation are discussed.

Keywords: User Innovation; User communities; Consumer innovators; Innovation Policy; Innovation System

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Chapter 1

Introduction and Research Objective

Introduction

Marketing myopia occurs when a company focuses too much on its products and takes an inward-looking approach. A similar myopia-like phenomenon occurs in user innovation studies. Since the 1970s, a number of researches have shown that not only producers, but also users can innovate. Until now, researchers' attempts to explore these user innovators' characteristics focused on their motives and contributions. However, most such researches are case studies in certain specific product fields such as sports equipment, software, and scientific tools.

This thesis aims to take a step back from single detail case studies to look at the user innovation phenomenon from a broader perspective. Is user innovation a general phenomenon? To answer this question, each stakeholder that relates to user innovation is explored in turn.

In macroeconomics studies, the economic system is formed by three sectors—Households, Business, and Government. A similar structure is utilized in this thesis. Regarding the household sector, this thesis will explore whether user innovation in the household sector is a common phenomenon or simply occurs in specific rare cases. In order to determine the correct scenario, two large-scale consumer surveys were conducted in two countries, i.e., Japan and the United States. The frequency of user innovation, together with user innovator characteristics, demographic data, and motives for product development are collected.

For the firm sector, a number of firms are attempting to collaborate with user innovators. However, potential users are difficult to detect out of the large pool of user innovators. This research aims to offer a hint to those firms by first addressing the

difference in user innovators' characteristics. Two types of user innovators are identified based on their status as a member of a community. This community-belonging criterion was selected because existing research shows that innovation is diffused and adopted rapidly in user communities.

The last paper explored in this thesis is the government sector. Until now, public policy has been designed and implemented based on a producer-centered paradigm. However, market and system failures such as high R&D costs and patents further discourage users from innovating. So far, no countries have considered supporting user innovation. Nevertheless, in 2007, Denmark became the first country that recognized the importance of users and launched a "User-driven Innovation Program." This leads to my research in studying how governments should support user innovation by examining such support in practice via a case study of the Danish user-driven innovation program.

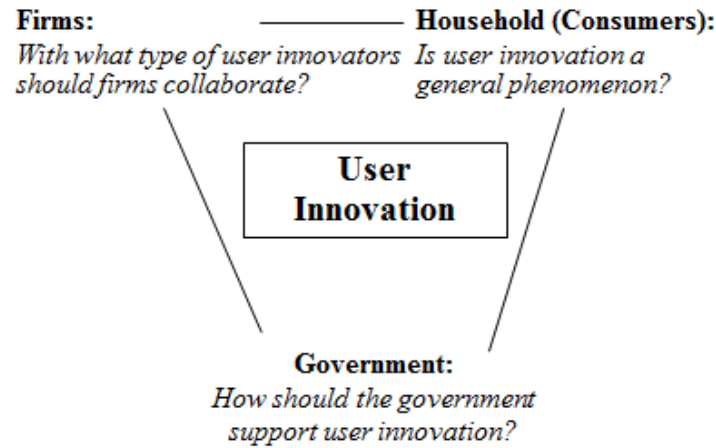
Research Objective and Contribution

Existing research shows that user innovation occurs in a wide range of product categories such as software, sports products, and services. Users innovate either alone or with other community members who share similar interests. For firms, user innovators provide innovative ideas and products, thus helping R&D staff better understand customer needs. At a national level, user innovators increase knowledge spillovers and help firms invest in the development process more efficiently.

However, most research exploring user innovation is based on case studies or small sample studies (Bogers et al., 2010). It remains difficult to conclude whether user innovation is a general phenomenon that is accessible to firms interested in collaborating with users or if it is simply a niche phenomenon that researchers happened to discover. collaborate with users or it is simply a niche phenomenon that researchers happen to discover.

This study aims to fill this gap by examining three aspects of innovation-related players on a large scale. Figure 1-1 summarizes the scope and the research questions of this thesis, which comprises three studies.

Figure 1-1: The Scope of the Thesis



1. User Aspect – Is user innovation a general phenomenon? Chapter 3

In order to understand user innovation from a wider perspective, this research will explore user innovation at the national level in two developed countries—the United States and Japan. I aim to investigate whether user innovation is a general phenomenon or occurs only as specific incidents in limited product categories. The answer to this question is significant for understanding the phenomenon of user innovation research as the result will provide a macro view of user innovation at a national level and can be applied to innovation policy in the future.

2. Firm Aspect – With what type of user innovators should firms collaborate? Chapter 4

User innovators have great potential and innovative product ideas. Their innovations can later become widely adopted by other users. The national surveys

conducted in Japan and the United States and discussed in Chapter 3 reveal that a significant number of user innovators exist. However, it remains unknown what type of user innovators will have the best potential to engage in collaboration with firms that will yield commercial success.

Subsequent studies show that user innovators freely reveal their innovation and have high capabilities in innovating products that the market later needs. Community users tend to share similar characteristics but some specific behaviors such as information sharing and peer-to-peer assistance can also be observed.

These different behaviors may lead to wider adoption of their innovations. The more the users help and share their innovations with colleagues, the greater the opportunities for those innovations to be more widely adopted. However, none of the existing research compares community users and solo user innovators, the latter of whom tend to innovate alone. This issue is important as it offers an empirical comparison between the two types of user innovators, which can inform firms' decisions about the type of users with whom they should collaborate and which approaches are most appropriate to motivate user innovators to engage with firms.

Thus, this study aims to compare demographic variables, behavioral variables, and motivations for product development between community innovators and solo innovators. The implications for firms are later discussed.

3. Government aspect – How should the government support user innovation? Chapter 5

In Chapter 3, we learned that user innovation is a general phenomenon that exists in a wide range of product categories. In Chapter 4, a specific type of user innovator is identified. They have high potential in successfully having their innovations adopted widely, and can be sources of ideas or collaborators with firms looking for new product ideas.

As a significant number of user innovators exist and they are an important resource for innovation, governments should concern about this issue and support user innovators' activities. User innovation researchers have in the past provided advice and suggestions for policymakers such as encouraging firms to adopt more user-generated innovation. However, none of these ideas were actually implemented.

In 2007, Denmark became the first country in the world to attempt to support user innovation by launching the "User-driven Innovation Program." This research aims to document the background to its implementation, its results, and the specific mechanisms through which user innovation is supported. Efficient approaches to initiate national support for user innovation will be discussed later.

Chapter 2

Literature Review

Introduction

It has long been assumed that companies develop products and service for customers. However, in 1970s, Eric von Hippel is the first researcher who explicitly focuses on the role of users as innovators. *User innovators* are defined as those who develop an innovation for their own use. They benefit from “*using*” the products. On the other hand, producer innovators are those who innovate and benefit from “*selling*” the products (von Hippel, 1988; von Hippel, 2005).

In reviewing literature related with user innovation, I divided the research into three streams, which show the development of understandings towards user innovation and user innovators.

1. The Prevalence of User Innovation

The research in this stream attempts to find the existence of user innovators and user innovation in various products and industries. The very first research in discovering user innovation is von Hippel (1976). Von Hippel (1976) found that among 111 innovations in scientific instruments, all of the basic instrument and 81% of major improvement innovations were done by users. This study raises researchers’ attention to the role of users as innovators.

Consecutive studies during late 1970s until 1990s mainly explore in business products which users are firms that use equipment or material to produce goods or services. In the semiconductor manufacture and electronic subassembly manufacture fields, users developed 67% of significant equipment innovations (von Hippel, 1976).

Herstatt & von Hippel (1992) found that 36% of pipe hanger users built their own prototype products. In the OPAC information search system for libraries, 26% of library staffs modified the software by themselves, and they are willing to share their innovation to others for free (Morrison, et al., 2000). Lettl et al. (2006) found that in all cases, users (physicians) are the originators and inventors of the radical innovations in the medical field.

Users innovate because they know what they want and existing products in the market do not fulfill their specific needs (von Hippel, 2005). For instance, OPAC library software users modified the software even though 72% of the respondents claimed that they were satisfied with the product. One respondent modified the software to display “book retrieval instructions for staffs” because it was difficult for staff to find books without precise directions (Morrison et al., 2000). Apache OS server software security users who modified the product on their own tend to be more satisfied than non-innovating users (Franke & von Hippel 2003).

During 2000s, increasing number of studies explore user innovation in consumer products. The first study was implemented by Sonali Shah. She investigated 57 important skateboarding, snowboarding, and windsurfing equipment innovations and found that users developed 100% of the first-of-type innovations, and developed 58% of all major improvement innovations (Shah, 2000). Luthe et al. (2004) and Franke and Shah (2003) also found user innovators who developed their own outdoor products. Other examples of user innovators’ products include mountain biking (Luthje et al., 2002), rodeo kayaking (Baldwin et al., 2006), sailing (Raash et al., 2008), and juvenile products (Shah and Tripsas, 2007). In late 2000s, some recent studies found user innovation in intangible products. von Hippel and Oliveira (2009) found that 85% of banking services were generated or suggested by users.

Table 2-1 and Table 2-2 summarize literature about the prevalence of user innovation since 1970s.

Table 2-1: The Prevalence of User Innovation in Industrial Products¹

Product area	Percentage of developing innovations for own use (N= Sample size)
Printed circuit CAD software (Urban and von Hippel, 1988)	24.3% (N=136)
Pipe hanger hardware (Herstatt and von Hippel, 1992)	36% (N=74)
Library information systems: OPAC (Morrison et al., 2000)	26% (N=102)
Apache OS server software security features (Franke and von Hippel, 2003)	19% (N=131)
Medical robots and systems (Lettl et al., 2006)	5 Case studies

Table 2-2: The Prevalence of User Innovation in Consumer Products²

Product area	Percentage of developing innovations for own use (N= Sample size)
Outdoor consumer products (Luthje, 2004)	9.8% (N=153)
Mountain biking equipment (Luthje et al., 2004)	19.2% (N=2005)
Moth sailboats (Raasch et al., 2008)	64.2% (N=53)
Banking service (von Hippel and Oliveira, 2009)	85% (N=40)

¹ Adapted from von Hippel (2005), Shah and Tripsas (2007) and von Hippel, et.al (2010)

² Adapted from von Hippel (2005), Shah and Tripsas (2007) and von Hippel, et.al (2010)

Apart from the evidence of user innovation in various fields and products, extant research in this field also found that most user innovators share two common characteristics. First, they are ahead of an important market trend. They are the first to realize the necessity of innovation. Their innovation becomes attractive and later widely adopted by other users. Franke and Shah (2003) found that when comparing with users who did not innovate, user innovators tended to spend more time in sporting activities and they informed that they had central role in the community.

The second characteristic of lead users is the high expected benefit. User innovators expect relatively high benefits from obtaining a solution to their needs (von Hippel, 2005). For example, in the sport equipment industry, some users modified the product so that they can play sports easier, safer, or more fun (Luthje, 2004). In the baby products, one mother tried to find a safe and comfortable baby seat in the car but found none, so she developed her own. As her generated product became popular, she established her own company (Shah and Tripsas, 2007).

Users who hold these characteristics are labelled as “*Lead users*”. Lead users tend to have more knowledge in the product they innovate than normal users (Schreier and Prugl, 2008). They are active in sharing knowledge to the communities they belong and tend to hold the leader position in the communities (Jeppesen and Laursen, 2009).

Lead users are beneficial for firms in many different ways. Firms can learn users’ heterogeneous needs and innovative solutions. Studies have found that user-generated products tend to be ahead of trends and may later be widely adopted by other users (von Hippel 1976; Luthje 2004; Oliveira and von Hippel 2009). Among white water kayakers, for instance, user innovators have developed most of the important innovations—and their innovations are frequently more cost-efficient than corporate innovations (Hienerth, von Hippel, and Jensen 2012).

Moreover, firms that can foster user innovation or integrate users into their development process enjoy the advantage of understanding users' latent needs (Eisenberg 2011) and co-creating innovative products. Some software companies recruit outstanding members from communities such as the Apache and LINUX communities. LEGO launched a platform called LEGO Cusoo and asked users to submit the design and voted (Nishikawa et al., 2013). As these lead users are opinion leaders in their communities, collaboration with them can generate market acceptance and diffusion (Hienerth and Lettl 2011), as well as bringing expertise to the product development process.

2. User community studies

In the late 1990s, as the Internet became more generally accessible, cooperation among users developed in online communities focused on particular interests. By the early 2000s, researchers began to focus on innovation in these communities, exploring users' activities in them and their motives for product development (Franke and Shah 2003; Lakhani and Wolf 2003).

The term "*community*" refers to the networks of interpersonal ties that provide sociability, support, information, a sense of belonging, and social identity (von Hippel, 2005). A number of past studies have stressed innovation in user communities and the value communities can provide for user innovators.

Community users' characteristics

One of the characteristics commonly observed in innovation communities is that community users assist one another in shaping their ideas or developing new products. Franke and Shah (2003) discovered that in sports communities, members receive and/or provide assistance in the process of improving the functionality and quality of the

innovation. In online software communities such as those devoted to LINUX and the Apache Server software, members help others fix bugs or solve problems (Raymond, 1999; Lerner and Tirole, 2002; Hertel et al., 2003; von Hippel and von Krogh, 2003). In the field of medical equipment, user innovators were found to collect knowledge and information from their micro-communities such as other surgeons and medical equipment manufacturers, who helped the user innovators to develop their prototypes (Hienerth and Lettl, 2011).

Moreover, users also tend to share information or reveal their innovations in the community. In the iron and steel industry, for example, firms have been found to reveal their knowledge to other firms by way of informal disclosure and publications in engineering literature (Allen, 1983). In open source software communities, users publish their code in the community so that other users can find, use and/or improve upon it. Shah and Tripsas (2007) found that mothers engaging in juvenile product innovation frequently belonged to some sort of community, such as a school, church or online community. One surgeon revealed his new implant approach for hernia surgery at a medical conference, and the approach was later adopted by other surgeons and ultimately became the standard worldwide (Hienerth and Lettl, 2011).

Some firms consider these community users' activities important for their product development, so they have begun to cooperate with community users by setting up a brand or product community for users. For example, LEGO commercializes products created or designed by users in its community (Antorini et al. 2012). MUJI, a large retailer of household and lifestyle goods in Japan, asks community members for ideas and opinions about product designs (Ogawa and Piller, 2006). Propellerhead, a manufacturer of musical instrument software, puts its prototypes on a chat hub so that users can collaborate in product development and give their opinions. In this way, users have helped the company modify and test its products. Recognizing the potential of users,

the company later established its own online community to communicate directly with its users (Jeppesen and Frederiksen, 2006).

In some cases, companies do not establish their own communities, opting instead to collaborate with users in existing communities. Füller et al. (2007) investigate online basketball communities and find that users in the Nike Talk community are willing to reveal their thoughts with the manufacturer at no charge. Nike thus gains unbiased feedback on its products at comparatively low cost.

Table 2-3 summarizes past studies and the types of communities identified. Community studies have been conducted for various types of innovation, ranging from sports equipment to software and medical equipment.

Table 2-3: Types of Innovation in Community User Innovation Studies

Types of Community	Source	Type(s) of Innovation
<i>User communities</i>	Franke and Shah (2003)	Sailplaning, canyoning, boardercross, handicapped cycling
	Hiennerth and Lettl (2011)	Kayaking, medical equipment
	Shah and Tripsas (2007)	Youth products
	Raymond (1999)	Open source software
	Lerner and Tirole (2002)	Open source software
	von Hippel and von Krogh (2003)	Open source software
	Lakhani and von Hippel (2003)	Open source software
	Lakhani and Wolf (2003)	Open source software
<i>Firm-sponsored communities</i>	Jeppesen and Molin (2003)	Online games
	Ogawa and Piller (2006)	Consumer products (e.g. T-shirts)
	Fuller et al. (2007)	Online basketball communities
	Jeppesen and Frederiksen (2006)	Computer-controlled musical instruments

3: National studies and implication to policymakers

In a national level, user innovators also help increasing the social welfare in the society or the country. Differing from firms, users are not enthusiastic in applying for intellectual property rights or patent (von Hippel and DeMonaco, 2014). They are willing to freely reveal their innovation or ideas to their friends, communities, or in public spaces such as websites. This users' free revealing behaviour will decrease the dead-weight loss in the society and increase knowledge spillover. The society where user innovators exist and contribute their innovation will have social welfare higher than the society where only producers are the innovators (Henkel and von Hippel, 2005).

Furthermore, user innovation alleviates the market failure. For companies, it is hard to predict the successful rate of their new products before the market launch. By one estimate, 67 percent of all new products introduced by established companies fail (Kotler, 2012) due to design problems or overestimation of market size. Collaboration with users or adopting user innovators' ideas can help firms understand customers' needs better and increase the success rate (Lilien et al., 2002; von Hippel and de Jong, 2010). Firms can efficiently invest resources in research and development.

Research in this stream attempts to collect national data about user innovators' activities so as to prove the existence of user innovation in a nationwide and provide policymakers better understandings towards user innovation in general. Then, propose national strategies to support user innovation.

The first national studies in this field explore business user innovators. So far, there are three countries--Canada, the Netherlands, and Korea, which have already been studied. Researchers find that user innovation rate ranges from 3.2% to 25% (de Jong and von Hippel, 2008; Gault and von Hippel, 2009; Kim and Kim 2010).

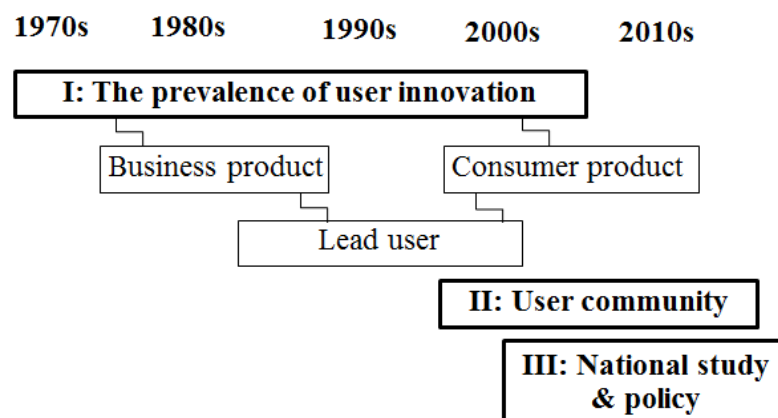
More recent studies conduct national surveys among consumers. The first study in consumer innovators was the study in the United Kingdom (Flowers et al., 2010).

Comparative studies were conducted in Japan, Finland and the United States (Ogawa and Pongtanalert, 2011; Kuusisto et al., 2013).

In order to support users' innovation activities, government should eradicate the barriers that demotivate user innovators such as strict intellectual property rights (von Hippel, 2005). Moreover, the government can also support by enhancing users' capabilities in innovation such as provision of technical education or better internet environment (Flowers et al., 2010; de Jong et al., 2010).

Figure 2-1 summarizes three streams in user innovation studies since 1970s.

Figure 2-1: User innovation studies since 1970s



Chapter 3

The Existence of User Innovators in a National Level: Consumer Innovation Survey in Japan and the United States

Introduction

Each year, manufacturers spend a large amount of money on research and development so as to understand customers' need or collect new ideas. Based on the collected data, they develop new products with an expectation that their innovation will become a great hit in the market. However, existing research shows that most firms are likely to encounter failure when they commercialize their products (Poolton and Barclay, 1998; Redmond, 1995).

This market commercial failure reflects the lack of real understanding of users' needs. Users who developed products on their own can alleviate this problem as they know their needs best. Innovations by users can bridge the gap between manufacturers' understanding on the market needs and users' real need (Ogawa, 1998). Significant research proves that user innovation is novel and is preferably adopted by other users (Shah and Tripsas, 2007; Franke and Shah, 2003; Luthje and Herstatt, 2004). User innovators are the generators of various significant innovation (von Hippel, 2005).

As user innovators tend to freely reveal their innovation, they reduce the firms' commercial failure and R&D cost. This reflects in the increasing of social welfare in the society (Henkel and von Hippel, 2005). Thus, it is significant that the Government supports user innovators' activities.

The supported data for public policy planning is insufficient (von Hippel, 2005). Most empirical research explores user innovation in case studies or specific product categories such as open source software (Bogers, 2010). Despite the fact that several countries such as Canada, the Netherland, and Korea initiated national innovation

surveys in firms (Gault and von Hippel, 2009; de Jong et al., 2009; Kim and Kim, 2010), the data about innovation developed by consumers is lacking. So far, the United Kingdom is the only country that collects data about consumer innovation.

In this paper, I aim to fulfill this gap by exploring consumer innovation in Japan and the United States. Online surveys were conducted during 2010 and 2011 with approximately 2,000 respondents in each country. Significant points including innovators' demographic background, information revealing, rate of adoption, the protection of innovation, and motives for product development were collected.

I find that user innovation exists in both countries and consumers developed products in a wide range of categories. However, the rate of adoption by other people or firms is still low. They do not have specific reasons to reveal their innovation. These findings suggest that consumers can be a valuable source of innovation but the mechanism of information revealing in the society is still lacking. The concluding discussion suggests how the government should motivate consumers in revealing their innovation.

Literature Review

User-centered innovation model

It has long been assumed that producers are the innovators. However, a considerable amount of theoretical and empirical research shows that users also develop products for their own use. Producers innovate because they expect to benefit from selling. They tend to use solution information they already have, and they have better knowledge about design, product development, and marketing than do users (Ogawa, 1998; von Hippel, 1994). In contrast, users expect to benefit from using the product. They innovate because they cannot find the product they want in the market; thus, they are superior to producers in accessing user-needs information.

Prior research shows that a number of major product developments were developed by users (von Hippel, 1976; von Hippel and Oliveira, 2009). User innovators can be found in a wide range of industrial and consumer products including Printed circuit CAD software (Urban and von Hippel, 1988), Library information systems (Morrison et al., 2000), Outdoor consumer products (Luthje, 2004) and Banking services (von Hippel and Oliveira, 2009).

User innovators are significant because they help producers improve innovation success. The products that leading users innovate become a major trend in that category later on (von Hippel, 1988). In addition, while firms use intellectual property rights to protect their innovations, users often freely reveal their innovations (Morrison et al., 2000; von Hippel, 2005). User innovators thus decrease the deadweight loss in society. The societies where user innovators exist and contribute their innovations will have higher social welfare than those where only producers innovate (Henkel and von Hippel, 2005).

User innovation survey in a National Level

However, there is no prominent data that collect user innovators' activities and their contribution to the country. Since 2007, there has been an attempt to measure the degree of consumer innovation in a national level. In 2007, Statistics Canada conducted a survey of advanced manufacturing technologies companies (e.g. a company that uses laser light to cut materials) in order to estimate the development of technologies, cost, the protection and the diffusion of process innovations (Gault and von Hippel, 2009). Similar surveys were conducted in the Netherlands regarding with small and medium companies, and in Korea which the respondents were manufacturing firms (de Jong and von Hippel, 2008; Kim and Kim, 2010).

The survey results indicate that user innovators, either advanced technology

companies or small companies, exist in every country, with 15% to 48% of manufacturers developing products for their own use. (See Table 3-1 below)

Table 3-4: The Prevalence of User Innovation in a National Survey

Country	Year of survey	Samples		Frequency
Canada (Fred Gault and von Hippel, 2009)	2007	6,478	Specific advanced manufacturing technologies companies	43%
Netherlands (de Jong and von Hippel, 2008)	2007	498	Hi-technology small and medium sized firms (1-100 employees)	54%
Netherlands (de Jong and von Hippel, 2008)	2008	2,416	Dutch small and medium sized firms (1-100 employees)	21%
Korea (Kim 2010)	2008	370	manufacturing firms with more than 10 employees	17.7%
United Kingdom (Flowers et al., 2009)	2009	1004	small and medium sized firms (10-250 employees)	15%
EU (Flowers et al., 2009)	2009 ³	4,377	innovating companies ⁴ employing more than 20 persons	27.7% ⁵
United Kingdom (Flowers et al., 2009)	2009	1,173	individual end consumers	8%

While a growing number of researches investigate user innovation in the industries, none of the research has documented the consumer innovation. In 2009, the United Kingdom is the country that first performed a separate user innovator survey on consumers. The telephone survey took place in the UK with a sample size of 1,173 consumers age 18 or older. From the survey, 6.1% of respondents were found to be consumer innovators (Flowers et al., 2009).

³ Some data derived from the survey in 2007

⁴ Firms that engaged in any or all of the following innovative activities: introduced new goods, services, processes, logistics processes, organizational methods, applied for one or more patents, carried out in-house R%D or contracted out R%D.(Flowers et al., 2009)

⁵ The number is limited to only user product innovation. The same study also found that 30.3% of companies are user process innovators.

The survey found that consumer innovators' innovations are various, ranging from craft tools to medical products. The categories and numbers in the survey are listed below.

- (1) Craft and Shop tools (23.0%)
- (2) Sports and hobby (20.0%)
- (3) Dwelling-related (16.0%)
- (4) Gardening-related (11.0%)
- (5) Child-related (10.0%)
- (6) Vehicle-related (8.0%)
- (7) Pet-related (3.0%)
- (8) Medical (2.0%)
- (9) Other (7.0%)

Regarding with the adoption rate, only 17 % of consumer innovation in the U.K. were adopted by other consumers or companies. This implies that more than 80% of consumer innovators keep their creation just for their own use.

In this paper, I conduct the online surveys in order to investigate whether similar user innovation phenomenon also occur in other countries or not. Data is collected in Japan and the United States as both countries are developed country like the United Kingdom, and each country represents each continent; Asia and North America. This study will provide comparative and supportive data of the survey in the U.K., which represents the Europe continent.

Methodology

Sample and data collection

The surveys were conducted online, which was a different approach from the United Kingdom⁶. The reason for this was a desire to collect as large a sample as possible as similar as possible to the countries' demographic structures within the constraints of budget. From the UK survey I anticipated that the total number of consumer innovators in our sample would probably be less than 10.0%, and I determined that an online survey would be the most cost-effective means of collecting as large an innovation sample as possible.

The surveys were conducted in collaboration with Rakuten Research, Inc, the Japanese market research company, which contacted their consumer panel databases by electronic mail, requesting that they respond to a questionnaire found at a URL. A large-scale survey was conducted in the United States during December 15 to December 27, 2010, with a sample size of 25,200 respondents. Responses were received from 2,000 people (1,992 valid responses; response rate of 7.9%), and in Japan during February 15 to March 2, 2011. Questionnaires were sent to 34,923 people. Responses were received from 2,000 people (2,000 valid responses; response rate of 5.72%).

My goal is to collect a sample that was representative of national populations of Japan and the United States. The research company therefore referred to response rates to census data to distribute questionnaires to consumers age 18 or over so that genders, ages, and locations matched the population structures of their countries. The reason for limiting the sample to respondents age 18 or older was for consistency with the UK survey.

⁶ The U.K. study used computer-assisted telephone interviewing method. The number of samples is 1,173 consumers.

Questionnaire

A questionnaire was used to ask questions of consumers in three parts. The first part contained questions about demographic variables (gender, age, employment status, education type and attainment). The second part asked about consumer innovation developed in the preceding 3 years. The respondents were asked separately about instances in which they might have created a product from scratch, and instances in which they might modify a product. The UK survey distinguished between "software products" and "physical products;" these surveys did not. For example, we asked the following questions:

“During the past 3 years, did you create any products from scratch for your own (or family) use such as tools, toys, sporting equipment, cars, household equipment, software programs, or any other things?”

“During the past 3 years, did you modify ANY products you (or your family) use in your daily life, such as tools, toys, sporting equipment, cars, household equipment, software programs, or any other things to make them work for you? ”(Note: Please restrict yourself to original changes that the manufacturer did not plan for!)

For each innovation type (product creation and modification), respondents first indicated whether they had developed any such innovation during the past 3 years. When the answer was positive, I further asked open-ended questions in order to investigate their creation or modification. In cases where consumer said they had created multiple innovations, respondents were asked to describe only their most recent one.

The third part of the survey then collected data related to innovators' most recent innovations via a series of closed-end questions. In this section, we asked for estimates of how much time and money respondents had spent on their innovations, and whether respondents had collaborated with any others (consumers, manufacturers) to develop the

innovation. We asked if respondents had protected their innovations with intellectual property rights and whether they had shared their innovations with any others. Finally, we asked respondents whether they were aware of any others who adopted their innovation. (See Appendix-A for the full questionnaire)

Sample cleaning

The sample cleaning process can be divided into two steps. First, several screening questions were tested. The first checked for *originality*: If the respondent knew of others who had developed an equivalent “home-made” product, or if he or she knew of an equivalent product available on the market, the case was excluded from the sample.

The second checked for *degree of innovation*. If the product creation or modification did not contain a new function that did not exist in products available on the market or did not improve an existing product function by more than 10.0%, the case was excluded.

The third had to do with whether the innovation had been developed as part of the respondent’s job. If it had been, it was excluded. On-the-job innovations are already recorded in official innovation statistics, and I was interested only in innovations that consumers had developed during their uncompensated leisure time. A total of 77.3% (N=786, US) and 79.1% (N=405, Japan) of all claimed innovations (N=1017, US and N=512, Japan) were discarded in this first step of the cleaning process.

Next, the open-ended descriptions of all remaining claimed innovations provided by the respondents were examined and discussed by two members of the research team. The research team discarded the responses that lack of novel, user-developed content such as: “I replaced the fabric on my couch with new fabric,” or “I installed a [manufacturer-developed] software upgrade on my personal computer”. In this step,

50.6% (N=117, U.S.) and 50.0% (N=24, Japan) of the remaining sample were removed from the list. Finally, only about 11.2% (United States) and 16.2% (Japan) of the reported examples were found to be actual innovations by our criteria, providing a sample of 83 validated cases of innovations by Japanese consumers. In Japan, 73 respondents were labeled as "product creators and/or modifiers. In the United States, there were 104 respondents who were finally selected. They were labeled as “***Consumer Innovator***”. Note that the term “consumer innovator” is narrower than “user innovator” as the latter includes manufacturers. This study focuses on only consumers who developed or modified products.

Variables

There are three types of variables in this research. The first group is demographic variables. The second group is behavioral variables such as community belonging and information revealing. The last group is motives for product development variables. Table 3-2 and Table 3-3 include all the variables in this survey.

Table 3-2: List of Demographic Variables

Variables	Description	Value
Consumer Innovator	During the past 3 years, respondents created or modified any products from scratch for their own (or family) use such as tools, toys, sporting equipment, cars, household equipment, software program.	1. Yes 2. No 3. Don't know
Gender	Gender of the respondents	1. Male 2. Female
Age	Age of the respondents	1. Under 18 years old 2. 18-24 years old 3. 25-29 years old 4. 30-34 years old 5. 35-39 years old 6. 40-44 years old 7. 45- 49 years old

Variables	Description	Value
		8. 50-54 years old 9. 55-59 years old 10. 60-64 years old 11. 65 years old or older
Marital status	Marital status of the respondents	1. Married 2. Unmarried
Job	Type of the respondents' work	1. Director of company 2. Employee (white-collar) 3. Employee (non-white-collar) 4. Self-employed (Ex. commercial, industrial) 5. Self-employed (Ex. independent consultant, lawyer) 6. Part time worker 7. Housewife 8. Student 9. Not working (excluded retirement) 10. Retirement (not working) 11. Other
Type of education	The formal education field that the respondents received	1. Technical/engineering 2. Business/management 3. Arts 4. Social Science 5. Other 6. None
Level of Education	The highest educational attainment of the respondents	1. Ph.D or higher. 2. Master degree or equivalent 3. Bachelor degree or equivalent 4. College diploma or equivalent 5. High school diploma or lower 6. Other 7. None
Family members	The number of family members including the respondents	1. One 2. Two 3. Three 4. Four 5. Five 6. Six 7. Seven 8. Eight 9. Nine 10. More than 10
Personal income	The respondents' annual total net (after tax) income in US\$ from all sources in 2009	1. Less than US\$ 20,000 2. From US\$ 20,000 to less than 40,000 3. From US\$ 40,000 to less than 60,000 4. From US\$ 60,000 to less than 80,000 5. From US\$ 80,000 to less than 100,000

Variables	Description	Value
		6. From US \$100,000 to less than 120,000 7. From US\$120,000 to less than 140,000 8. From US\$140,000 to less than 160,000 9. From US \$160,000 to less than 180,000 10. From US\$ 18,000 to less than 200,000 11. US \$ 200,000 or more
Personal expenditure	The respondents' expenditure per month (monthly allowance) in 2009	1. Less than \$100 2. From \$100 to less than 200 3. From \$200 to less than 300 4. From \$300 to less than 500 5. From \$500 to less than 700 6. From \$700 to less than 1,000 7. From \$1,000 to less than 1,500 8. From \$1,500 to less than 2,000 9. More than \$2,000
Household expenditure	The respondents' household expenditure per month	1. Less than \$1,000 2. From \$1,000 to less than 2,000 3. From \$2,000 to less than 3,000 4. From \$3,000 to less than 4,000 5. From \$4,000 to less than 5,000 6. From \$5,000 to less than 6,000 7. From \$6,000 to less than 7,000 8. From \$7,000 to less than 10,000 9. More than \$10,000

Table 3-3: Variables about product creation/modification

Value	Description	Value
Behavioral Variables		
IPR	Whether or not the respondents' apply intellectual property rights to protect the product creation (e.g. patents, trademarks)	1. Yes 2. No 3. Don't know
Information revealing	Whether or not the respondents shared the details of this creation with other consumers or firms	1. Yes 2. No 3. Don't know
Adoption	Whether or not other people or organizations pick up, adopt or copy the respondents' creation or modification	1. Yes 2. No 3. Don't know
Receiving	In case the respondents' innovation	1. Yes 2. No

Value	Description	Value
Compensation	was developed, whether or not the respondents received any compensation	3. Don't know
Community belonging	Whether or not the respondents belong to a hobby club or a community with a special interest in the type of product they created or modified	1. Yes 2. No 3. Don't know
Receiving assistance	Whether or not the respondents develop the product creation with the help of others	1. Yes 2. No 3. Don't know
<i>Motives for product development</i>		
Necessity	Because the respondents needed that creation or modification	1: Strongly Agree 2: Agree 3: Neither agree nor disagree 4: Disagree 5: Strongly disagree
Enjoyment	Because the respondents enjoyed doing the creation or modification	1: Strongly Agree 2: Agree 3: Neither agree nor disagree 4: Disagree 5: Strongly disagree
Skill development	Because the respondents wanted to learn or develop their skills	1: Strongly Agree 2: Agree 3: Neither agree nor disagree 4: Disagree 5: Strongly disagree
Altruism	Because the respondents wanted to help someone else via the item created	1: Strongly Agree 2: Agree 3: Neither agree nor disagree 4: Disagree 5: Strongly disagree
Reputation	Because the respondents wanted to improve my reputation or gain respect.	1: Strongly Agree 2: Agree 3: Neither agree nor disagree 4: Disagree 5: Strongly disagree
Cost saving	Because it was less costly than purchasing the product in the market	1: Strongly Agree 2: Agree 3: Neither agree nor disagree 4: Disagree 5: Strongly disagree
Unfulfilled need	Because the firms or other people could not reach the respondents' needs	1: Strongly Agree 2: Agree 3: Neither agree nor disagree 4: Disagree 5: Strongly disagree

Findings

The following section comprises of four aspects of product innovation by American and Japan consumers: the incidence of consumer innovation, the demographic background of user innovators, the behavioral characteristics of consumer innovators, and their motives for product development and information revealing.

From the analysis, most of Japanese consumer innovators are male (63.9%) and get married (84.3%). Approximately half of the innovators are employed (45.8%). Compared to Japanese consumer innovators, the percentage of male and female innovators in the U.S. tends to be more balanced as approximately half of consumer innovators are male (56.1%). Around 56.1% of consumer innovators get married. The type of education that consumer innovators in both countries have most is arts including business school, arts, and laws. I expected more science students to innovate but the result shows that art students also developed and modified products. Table 3-4 shows all eight demographic variables of consumer innovators in Japan and the United States.

Table 3-4: Distribution of Respondents in Consumer Surveys

Variables	Japan (n = 73)	U.S. (n = 104)
<i>Gender:</i>		
Male	63.9%	56.1%
Female	36.1%	43.9%
<i>Marital Status:</i>		
Married	84.3%	56.1%
Single	15.7%	43.9%
<i>Age:</i>		
18-24 years old	1.2%	9.6%
25-34 years old	4.8%	18.4%
35-44 years old	19.3%	17.5%
45-54 years old	19.3%	26.3%
55-64 years old	28.9%	25.4%
More than 65 years old	26.5%	2.6%

Variables	Japan (n = 73)	U.S. (n = 104)
<i>Job:</i>		
Student/part-time	30.1%	25.4%
Employed	45.8%	52.6%
Unemployed/retired	24.1%	21.9%
<i>Educational Level:</i>		
Lower than high school	41.0%	23.7%
Further qualifications	16.9%	15.8%
University or higher	39.8%	57.0%
Others/Unspecified	2.4%	3.5%
<i>Type of Education:</i>		
Science	26.5%	21.1%
Art	39.8%	40.4%
None/Unspecified	33.7%	38.6%
<i>Level of Annual Income:</i>		
Less than 20,000\$	18.1%	14.0%
20,000-40,000\$	32.5%	20.2%
40,001-60,000\$	16.9%	27.2%
60,001\$-100,000\$	28.9%	21.1%
100,001\$-140,000\$	3.6%	12.3%
More than 100,001\$	0.0%	5.3%
<i>Monthly Expense:</i>		
Less than 100\$	25.9%	9.6%
101-300\$	13.3%	13.2%
301-500\$	16.8%	13.2%
501-1,000\$	20.5%	15.8%
1,001-2,000\$	8.6%	26.3%
More than 2,000\$	26.7%	21.9%
<i>Number of Family Members in Household:</i>		
Single	10.8%	19.3%
2-4 persons	80.7%	62.3%
More than 5	8.4%	18.4%

The Incidence of user innovation

The finding shows that the fraction of consumer innovation in Japan and the United States is in line with the survey in the U.K. In Japan, 1.7% of total respondents

developed products, 2.5% modified products, and 0.5% did both product development and modification.

The fraction of consumer innovation in the United States is slightly higher than in Japan. 3.0% of American consumers developed products, 2.8% of the respondents modified products, and 0.5% did both. This yields the fraction of consumer innovators in the United States as 5.2% and in Japan as 3.7%. Table 3-5 summarizes the result.

Table 3-5: Share of User innovators in Japan⁷ and in the U.S.⁸

User Innovation Rate	Japan (Total n = 73)	U.S. (Total n = 104)
Product development	1.7% (n= 34)	3.0% (n= 59)
Product Modification	2.5% (n= 49)	2.8% (n= 55)
Both	0.5% (n= 10)	0.5% (n= 10)
Total number of Consumer Innovators	3.7% (n = 73)	5.2% (n = 104)

Product Categories of Consumer Innovation

Similar to the result in the U.K. survey, consumer innovations in Japan and the United States are in a wide range of product categories. The category that consumers innovate most is dwelling-related products such as furniture and kitchen tools. Table 3-6 represents the example of consumer responses in each product category. Example of innovations in each category can be found from Table 3-7.

⁷ The total sample size is 2,000

⁸ The total sample size is 1,992

Table 3-6: User Innovations in Each Category

Categories	Japan	U.S.
Craft and shop tools	8.4%	12.3%
Sports and hobby	7.2%	14.9%
Dwelling-related	45.8%	25.4%
Gardening-related	6.0%	4.4%
Child-related	6.0%	6.1%
Vehicle-related	9.6%	7.0%
Pet-related	2.4%	7.0%
Medical	2.4%	7.9%
Other	12.0%	14.9%

Table 3-7: Examples of reported consumer innovations

Category	Example
Craft and shop tools	I made it from metal with a wooden handle. It is a scale creation tool for imprinting scales onto a clay dragon sculpture. You press it into the clay to create scale patterns so as to eliminate the need for carving each and every scale by hand. It reduces my time by hours.
Sports and hobby	I fixed the handle of a fishing rod by adding pipe insulation to it to make it easier for a handicapped person with little strength in her hands to spend time fishing.
Dwelling-related	Lost?, Find. Computer using GPS satellites and after you put a small tag on you items once they enter your home you can find any one of those items anywhere I used a computer, GPS, and small tags (metallic with GPS tracking)
Gardening-related	T-cut, gently bent the tops and then drove 16 inch re-bar stakes into the ground at key locations in my yard so that a garden hose could be pulled around without damaging plants, flower beds, etc.
Child-related	I created wooden water skis for my youngest to learn on
Vehicle-related	I modified harley davidson exhausts and developed new water cooling exhausts on harley davidsons.
Pet-related	I developed "squirrel less bird feeder". I put pvc pipe around bird feeder.
Medical	I attached a long tube to mug, attached stick to drinking end of tube. use stick to raise straw so I can drink unassisted because I cannot lift my arms
Other	My sister needed to get a spot for her son to attend an after school program. The site is internet based and first come first serve. I created a program to automatically enter her information as soon as the site opened thereby getting her the first spot available.

Demographics of Consumer Innovators

First, I analyze whether consumer innovators and non-consumer innovators have different demographic or not. In this context, *consumer innovators* mean consumers that created or modified the original product, which was unique and was not available in the market, for their own use or for other consumers without business purpose. *Non-consumer innovators* refer to respondents that created or modified the product but did not pass the screening questions (e.g., the product was a part of the job or the product was not original).

As all the demographic variables (gender, marital status, age, job, education, income, expense, and number of family members) are categorical data and the data is non-parameter⁹, Pearson's chi-square test is applied. This method is suitable for the analysis of the relationship between two categorical variables. Moreover, as the data is not normally distributed, logistic regression cannot be applied. First of all, I analyzed the relationship between the status of consumer innovators and each demographic variable.

According to Table 3-8, the result shows that in Japan, there was a significant association between the marital status and whether or not the respondents were consumer innovators and between the age and whether or not the respondents were consumer innovators. Consumer innovators tend to be older (more than 55 years old) and married.

Table 3-8: Frequency of Japanese consumer innovators and non-consumer innovators by demographic variables

	Consumer innovation	Non-consumer innovation	Significant level
Total (n = 492)	16.9%	83.1%	0.612
<i>Gender</i> ^a :	17.5%	82.5%	
Male (n = 302)	15.8%	84.2%	
Female (n = 190)			

⁹ The number of consumer innovator is 73 whereas the number of non-consumer innovators is 1927.

	Consumer innovation	Non-consumer innovation	Significant level
<i>Marital Status^b:</i>			0.002
Married (n = 345)	20.3%	79.7%	
Single (n = 147)	8.8%	91.2%	
<i>Age^c:</i>			0.000
18-24 years old (n= 61)	1.2%	98.4	
25-34 years old (n= 79)	4.8%	94.9	
35-44 years old (n= 89)	19.3%	82.0	
45-54 years old (n= 78)	19.3%	79.5	
55-64 years old (n= 92)	28.9%	73.9	
More than 65 years old (n= 93)	26.5%	76.3	
<i>Job^d:</i>			0.105
Student/part-time (n =184)	13.6%	86.4%	
Employed (n= 225)	16.9%	83.1%	
Unemployed/retired (n=83)	24.1%	75.9%	
<i>Educational Level^e:</i>			0.471
Lower than high school (n = 169)	20.1%	79.9%	
Further qualifications (n = 97)	14.4%	85.6%	
University or higher (n = 218)	15.1%	84.9%	
Others/Unspecified (n = 8)	25.0%	75.0%	
<i>Type of Education^f:</i>			0.200
Science (n = 166)	13.3%	86.7%	
Art (n = 193)	17.1%	82.9%	
None/Unspecified (n = 133)	21.1%	78.9%	
<i>Level of Annual Income^g:</i>			0.000
Less than 20,000\$ (n = 170)	8.8%	91.2%	
20,000-40,000\$ (n = 137)	19.7%	80.3%	
40,001-60,000\$ (n = 91)	15.4%	84.6%	
60,001\$-100,000\$ (n = 74)	32.4%	67.6%	
More than 100,001\$ (n = 20)	15.0%	85.0%	
<i>Monthly Expense^h:</i>			0.136
Less than 100\$ (n = 54)	25.9%	74.1%	
101-300\$ (n = 81)	13.3%	86.7%	
301-500\$ (n = 119)	16.8%	83.2%	
501-1,000\$ (n = 88)	20.5%	79.5%	
1,001-2,000\$ (n = 35)	8.6%	91.4%	
More than 2,000\$ (n = 15)	26.7%	73.3%	
<i>Number of Family Members in Householdⁱ:</i>			0.105
Single (n = 84)	10.7%	89.3%	
2-4 persons (n = 350)	19.1%	80.9%	
More than 5 (n = 58)	12.1%	87.9%	

^a $\chi^2(1) = .26, p=.61$; ^b $\chi^2(1)=9.63, p=.00$; ^c $\chi^2(5)=27.36, p=.00$; ^d $\chi^2(2)=4.5, p=.11$;
^e $\chi^2(3)=2.53, p=.41$; ^f $\chi^2(2)=3.22, p=.20$; ^g $\chi^2(4)=21.6, p=.00$; ^h $\chi^2(5)=8.39, p=.14$; ⁱ $\chi^2(2)=4.5, p=.11$

The U.S. survey represents slightly different results. Compared to those who did

not innovate, consumer innovators tend to be around 45-54 years old, ($\chi^2 = 25.93$ with $df = 5$, $p = .00$) and are still working ($\chi^2 = 10.11$ with $df = 2$, $p = .01$). Table 3-9 summarizes the demographic data of American consumer innovators.

Table 3-9: Frequency of American consumer innovators and non-consumer innovators by demographic variables

	Consumer innovation	Non-consumer innovation	Significant level
Total (n = 1,017)	16.9%	83.1%	
<i>Gender^a:</i>			0.593
Male (n = 547)	11.7%	88.3%	
Female (n = 470)	10.6%	89.4%	
<i>Marital Status^b:</i>			0.350
Married (n = 529)	12.1%	87.9%	
Single (n = 488)	10.2%	89.8%	
<i>Age^c:</i>			0.000
18-24 years old (n= 166)	6.6%	93.4%	
25-34 years old (n= 243)	8.6%	91.4%	
35-44 years old (n= 234)	8.5%	91.5%	
45-54 years old (n= 204)	14.7%	85.3%	
55-64 years old (n= 130)	22.3%	77.7%	
More than 65 years old (n= 40)	7.5%	92.5%	
<i>Job^d:</i>			0.006
Student/part-time (n =320)	9.1%	90.9%	
Employed (n= 567)	10.6%	89.4%	
Unemployed/retired (n=130)	19.2%	80.8%	
<i>Educational Level^e:</i>			0.012
Lower than high school (n = 299)	9.0%	91.0%	
Further qualifications (n = 228)	7.9%	92.1%	
University or higher (n = 435)	14.9%	85.1%	
Others/Unspecified (n = 55)	7.3%	92.7%	
<i>Type of Education^f:</i>			0.704
Science (n = 188)	12.8%	87.2%	
Art (n = 408)	11.3%	88.7%	
None/Unspecified (n = 421)	10.5%	89.5%	
<i>Level of Annual Income^g:</i>			0.439
Less than 20,000\$ (n = 164)	9.8%	90.2%	
20,000-40,000\$ (n = 267)	8.6%	91.4%	
40,001-60,000\$ (n = 212)	14.6%	85.4%	
60,001\$-100,000\$ (n = 204)	11.8%	88.2%	
100,001-140,000\$ (n = 115)	12.2%	87.8%	
More than 140,001\$ (n = 55)	10.9%	89.1%	

	Consumer innovation	Non-consumer innovation	Significant level
<i>Monthly Expense^h:</i>			0.115
Less than 100\$ (n = 112)	9.8%	90.2%	
101-300\$ (n = 203)	7.4%	92.6%	
301-500\$ (n = 106)	14.2%	85.8%	
501-1,000\$ (n = 190)	9.5%	90.5%	
1,001-2,000\$ (n = 253)	11.9%	88.1%	
More than 2,000\$ (n = 153)	16.3%	83.7%	
<i>Number of Family Members in Householdⁱ:</i>			0.449
Single (n = 84)	13.3%	86.7%	
2-4 persons (n = 350)	10.3%	89.7%	
More than 5 (n = 58)	12.7%	87.3%	

^a $\chi^2(1) = .29, p=.59$; ^b $\chi^2(1)=.88, p=.35$; ^c $\chi^2(5)=25.93, p=.00$; ^d $\chi^2(2)=10.11, p=.05$; ^e $\chi^2(3)=10.89, p=.01$
^f $\chi^2(2)=.70, p=.70$; ^g $\chi^2(5)=4.81, p=.44$; ^h $\chi^2(5)=8.84, p=.12$; ⁱ $\chi^2(2)=1.60, p=.45$

Expenditures by Consumer Innovators

All respondents were asked about the time and cost that they spent on innovation over 3 years. In Japan, the average cost was 1,479 dollars per year and the average days spent on innovation was 5.5 days per year. In the United States, the average cost and time spent were 1,725 dollars and 9.9 days per year. Table 3-10 summarizes the result.

Table 3-10: Cost of Consumer Innovation and the Frequency of Innovation

	Japan	U.S.
Average times of innovation per year	2.64	2.08
Average cost of innovation per year (\$)	1,479	1,725
Average spent time on innovation per year (days)	5.5	9.9

Next, I calculate the total investment of consumer innovators. First, I calculate the opportunity cost by multiplying the total number of days that consumer innovators spent with the average daily wage of that country. Then, I sum this opportunity cost with the monetary amount of all consumer innovators. Finally, I multiply the user innovation rate (3.7% for Japan and 5.2% for the U.S.) with the population age 18 year old or older. The final number shows the total amount that consumer innovators in the country spend.

As a result, for Japan 5.8 billion dollars, and for the United States, 20.2 billion dollars were spent in consumers' innovation activities. Next, I calculate the research and development cost of manufacturers in both countries by multiplying the national aggregate R&D investment with the ratio of consumer goods to total product transaction values in the country. The data is exported from the input-output table. Transaction value data is from Bureau of Economic Analysis in USA (2009) for the United States; the Statistics Bureau (2005) for Japan. For research and development investment, data from the National Science Foundation (2008) was used for the United States; from the Ministry of Internal Affairs and Communications (2007) for Japan.

As a result, Japanese manufacturers spent approximately 43.4 billion dollars whereas American manufacturers spent approximately 62 billion dollars on research and development. This means that Japanese consumers spent 13.3% of Japanese manufacturers R&D cost and American consumers spent approximately one-third of the manufacturers R&D expenditure. The amount of consumer investment in both countries is large and thus cannot be neglected.

Behavioral characteristics of consumer innovators

In this part, consumer innovators' behaviors such as community belonging, information revealing, and receiving helps from others were investigated.

Table 3-11 shows that 10.8% of Japanese consumer innovators and 13.2% of American consumer innovators belong to clubs or communities related with the type of products they created or modified. In Japan, approximately 8.4% received help from others during the product development process. American consumer innovators share similar rate with Japanese innovators as 11.4% of the innovators received help from others. However, they tend to share their innovation to others in a higher rate than Japanese consumer innovators (18.4% for U.S., and 10.8% for Japan).

The rate of adoption in both countries is low. Only 3.6% of Japanese consumer innovations were adopted or copied by organizations or other people whereas 6.1% of American consumer innovations were adopted. However, almost all of consumer innovators in both countries do not attempt to protect their innovation. Only 8.8% of American consumer innovators applied for intellectual property rights whereas none of Japanese consumer innovators applied.

Table 3-11: Percentage of Affirmative Responses to Consumer Innovators' Characteristics-related Questions

Consumers...	Japan (n = 83 ¹⁰)	U.S. (n = 114 ¹¹)
belong to a hobby club or community with a special interest in the type of product I created.	10.8%	13.2%
developed the product with the help of others.	8.4%	11.4%
shared the details of this product with other consumers or firms.	10.8%	18.4%
Other people or organizations take up, adopt or copy my creation.	3.6%	6.1%
applied for intellectual property rights to protect the innovation.	0.0%	8.8%

Though significant of money and time is invested in the product development, consumer innovators are willing to share or reveal their innovation to others free of charge. In the U.S. survey, among consumer innovators who claimed that their innovations were adopted by others, approximately half of them shared for free (n = 3; 43%). Moreover, all of Japanese consumer innovators shared their ideas to others or firms without charging any fee (n = 3; 100%).

¹⁰ The number of user innovators is 73 but the number of user innovations is 83. There are ten people who both developed and modified products and both of their creation and modification were counted.

¹¹ The number of user innovators is 104 but the number of user innovations is 114. There are ten people who both developed and modified products and both of their creation and modification were counted.

Motivations of Consumer Innovators

I next consider the motives of users in their product creation or modification efforts. Since users in our study develop various types of products, seven variables most commonly indicated in previous studies are applied in the survey: necessity, enjoyment, skill improvement, altruism, fame, cost saving, and the unfulfilled need.

In the questionnaire, I used a five-likert scale¹² comprising seven motives to ask users to report the reasons why they had created or modified products (see Table 3-12). In both Japan and the U.S., the motives that consumer innovators rate highest are necessity and enjoyment respectively.

Table 3-12: Consumer Innovators' Motives in Product Development

Variables	I created/modified a product...	Mean of Consumer Innovator (Japan) (n = 83)	Mean of Consumer Innovator (U.S.) (n = 114)
NECESSITY	...because I needed it myself.	4.65	4.54
ENJOYMENT	...because I enjoyed doing it.	4.20	4.17
SKILL DEVELOPMENT	...because I wanted to learn or develop my skills.	3.31	3.51
ALTRUISM	...because I wanted to help someone else with the item created.	3.07	3.33
REPUTATION	...because I wanted to improve my reputation or gain respect.	2.60	2.81
COST SAVING	...because it was less expensive than purchasing the product on the market.	3.69	3.50
UNSATISFIED NEED	...because firms or other people could not fulfill my needs.	3.06	3.48

1 = Strongly disagree; 5 = Strongly agree

Next, respondents who replied “I shared the details of the innovation” were asked about their motives for revealing their innovation. According to Table 3-13, the motive

¹² Five means strongly agree whereas One means least agree.

that Japanese innovators rated most is the expectation that somebody will accept their innovation and that they may receive rewards. On the other hand, American innovators rated “No particular reason” most.

Table 3-13: Consumer Innovators’ Motives in Information Revealing

Variables	I share the details of the innovation with other people or firms ...	Japan (n = 9)	U.S. (n = 21)
ADMIRE	...because I wanted my idea to be accepted (or admired) by other people or firms	2.22	2.29
IMPROVE	...because I wanted my idea to be developed further by other people (wanted my product to be improved better)	2.11	2.29
REWARD	...because I expected my idea would be accepted by other people or firms and I may receive financial reward	3.56	2.29
B4BENEFIT	...because I had benefitted from other people’s ideas before	3.33	2.29
NOTHING	...because I did not expect any admiration or benefits (I created without any particular reasons.)	2.56	2.38

1 = Strongly disagree; 5 = Strongly agree

Conclusion

The consumer innovation surveys in Japan and the United States show that a significant number of consumer innovators exist. Existing research explores user innovation in specific product categories such as open source software and sports-related products. This research confirms their findings and shows that user innovation is not a specific or unique phenomenon but exists in a wide range of products even complex products such as automobile.

Another significant finding is that consumer innovators do not attempt to protect their innovation even though they invested a substantial amount of money and time on

their innovation. Yet, the rate of information revealing and the adoption rate were still low (less than 20%). Recall from Table 3-13 that the respondents rate “no particular reason” as their motive for information revealing pretty high. This implies that most consumer innovators do not reveal because they do not have particular reasons to do so.

It is significant to motivate consumer innovators to reveal their innovation because previous research shows that a number of significant innovations are created by users. The more user innovators reveal, the more benefits the society and the country gain. In order to create this spillover of knowledge, firms and government should provide the right incentives for users to reveal their innovation such as financial rewards or recognition. The patterns of revealing mechanism are varied such as idea competition. Firms may provide website that user innovators can post their innovation.

The existing national surveys include this study indicate some differences in consumer innovators’ characteristics such as demographic and motives for product development. Future research may explore in those differences and compare among countries.

Chapter 4

Differences in behaviors and motives of

Community Innovators and Solo Innovators: A comparison study

Introduction

User innovators can potentially serve as a significant source of innovative ideas for firms. Studies have found that user-generated products tend to be ahead of trends and may later be widely adopted by other users (von Hippel 1976; Luthje 2004; Oliveira and von Hippel 2009). Among white water kayakers, for instance, user innovators have developed most of the important innovations—and their innovations are frequently more cost-efficient than corporate innovations (Hienerth, von Hippel, and Jensen 2012). Firms that can foster user innovation or integrate users into their development process enjoy the advantage of understanding users' latent needs (Eisenberg 2011).

While some users innovate on their own, to solve an individual problem or meet a need, others gather in communities focused on a particular activity, such as whitewater kayaking or open source software networks. In the late 1990s, as the Internet became more generally accessible, cooperation among users developed in online communities focused on particular interests; by the early 2000s, researchers began to focus on innovation in these communities, exploring users' activities in them and their motives for product development (Lakhani and Wolf 2003; Franke and Shah 2003). This early work suggested that community user innovators innovate not only out of necessity—because available products do not fulfil a need—but also for other reasons, such as enjoyment and reputation (Raymond 1999; Jeppesen and Frederiksen 2006).

These earlier studies did not explicitly explore the differences between community innovators and lone user innovators. However, they do suggest that some differences must exist. Where individual user innovators innovate alone, community

users collaborate with one another in shaping their ideas and developing products, and they are willing to reveal their innovations in the process. Moreover, the emotional motivations researchers identified in community innovators have not been observed in users who innovate on their own.

This research intends to fill this gap by comparing the motivations and behaviours of community vs. solo user innovators. This perspective is important because it offers an empirical comparison between the two types of user innovators, which can inform firms' decisions about the type of users they should collaborate with and which approaches are most appropriate to motivate user innovators to engage with firms.

Literature Review and Hypothesis

Innovation communities and the characteristics of community users

Past research reveal that user innovators are significant source of innovation. They innovate because they need the product and often freely reveal their innovation. Later studies find that there are some user innovators who do not innovate alone, but belong to communities which members share similar interest and help one another innovate.

User Communities are defined as networks of interpersonal ties that provide sociability, support, information, a sense of belonging, and social identity (von Hippel, 2007). User communities emerge and center on a certain topic or field of shared interest (Hienerth and Lettl, 2011).

Receiving Assistance

One of the characteristics commonly observed in innovation communities is that users tend to help one another in shaping their ideas or developing new products. Franke and Shah (2003) discovered that in sports communities, members receive and/or provide

assistance in the process of improving the functionality and quality of the innovation. User innovators themselves are satisfied with the assistance they receive. In online software communities such as those devoted to LINUX and the Apache Server software, members help others fix bugs or solve problems (Raymond, 2000; Hertel et al., 2003; von Hippel and von Krogh, 2003). In the field of medical equipment, user innovators were found to collect knowledge and information from their micro-communities such as other surgeons and medical equipment manufacturers, who helped the user innovators to develop their prototypes (Hienerth and Lettl, 2011).

Moreover, users also tend to share information or reveal their innovations in the community. In the iron and steel industry, for example, firms have been found to reveal their knowledge to other firms by way of informal disclosure and publications in engineering literature (Allen, 1983). In open source software communities, users publish their code in the community so that other users can find, use and/or improve upon it. Shah and Tripsas (2007) found that youths engaging in product innovation frequently belonged to some sort of community, such as a school, church or online community. One surgeon revealed his new implant approach for hernia surgery at a medical conference, and the approach was later adopted by other surgeons and ultimately became the standard worldwide (Hienerth and Lettl, 2011).

However, this peer-to-peer assistance in other types of user innovators has not been explored. In the previous national consumer studies in Japan and the United States in Chapter 3, 8.4% of Japanese consumer innovators, and 11.4% of U.S. innovators receive assistance. The number is not high and cannot be concluded that receiving assistance is a common behavior for user innovators or simply a specific characteristics of some types.

Community members tend to contribute and receive assistance more than user innovators who are independent as communities can yield a collective effort result

(Karau and Williams, 1993; Ling et al., 2005). People tend to contribute to the activities more when they believe they are similar to other people in the group (Ling et al., 2005). Thus, this leads to our first hypothesis as:

H1: User innovators who belong to communities tend to receive assistance than user innovators who do not belong to communities.

Adoption of Innovation

User innovators have developed a number of significant innovations that are widely diffused. A number of community users have developed and improved Apache until it became the most popular Web server (von Hippel and von Krogh, 2003). In the case of brand MUJI, the sales of community user-design household product is higher than firm-design product (Ogawa and Piller, 2006; Nishikawa et al., 2012).

However, von Hippel et. al (2012) found that in general, only 5 to 17% of consumer-generated products were actually adopted by peers or companies. As community users reveal and help one another in developing innovation, the adoption rate of their innovation may be higher than other types of user innovators. It is therefore hypothesized:

H2: The innovations of user innovators who belong to communities tend to be adopted than those of user innovators who do not belong to communities.

Demographic Background

Compared to general users, users that innovate tend to have lead user characteristics. They are at the leading edge of an important market trend (von Hippel, 2005). They have high skills in related technologies and have used that product for long time (Morrison et al., 2000; Luthje, 2004; Tietz et al., 2005). The result of consumer innovators in a national survey supports this finding. Consumer innovators are likely to

be highly educated, have a technical education and to be male (von Hippel, Ogawa, and de Jong, 2012).

In user community studies, as the samples are in case studies or specific product categories, most studies investigate the length of community membership, the time and money spent in community, and the level of engagement in community activities (Franke and Shah, 2003). Community users may be young and single as they have more leisure time than married couples. However, their demographic background has not been collected yet.

Thus, we propose that community innovators and solo innovators may have different demographic backgrounds such as age, gender, level of education, and type of education. This yields our next hypothesis.

H3: User innovators who belong to communities have different demographic background as those who do not belong to communities.

Motives for product development or modification

In general, users innovate because their needs are not adequately met by existing products from firms (von Hippel, 1998; 2005). Encountering with problems or difficulties in medical tools, some leading physicians developed radical innovation or collaborated with colleagues and/or firms in solving the problems (Lettl et. al, 2006).

User innovators develop products in order to solve their specific problems or satisfy their own needs, which existing products cannot fulfill. However, recent studies found that users who belong to communities innovate not only because they need the product but also other reasons such as enjoyment and altruism.

Some users such as Open Source Software community members regard the product development process, in this case fixing bugs, as enjoyable process even though it is time-consuming (Raymond, 2000; Lerner and Tirole, 2002; Hertel et al., 2003).

Lakhani and Wolf (2003) note that users frequently lost track of time during the programming process. Enjoyment is the top reason why OSS members contributed to the projects. Füller et al. (2007) also found that some users, which they classify as “excitement-driven innovators”, create products because they derive enjoyment from the innovation activity.

Moreover, some users innovate so as to be able to improve their skills. Open source software members participate in a community and learn to produce their own code (Lerner and Tirole, 2002; von Hippel and von Krogh, 2003). Lakhani and Wolf (2003) found that compared to paid contributors, volunteer users (users who work without compensation) tend to participate because they want to improve their skills.

A survey of the Apache software community shows that users tend to help other members because they have received assistance or expect to receive help from the community (Lakhani and von Hippel, 2003).

Another motive that drives users to innovate is reputation or recognition that may lead to job opportunities. Linux developers are motivated to fix bugs in order to enhance their reputation in the eyes of the community (Raymond, 2000; Lerner and Tirole, 2002; Hertel et al., 2003). Some merely wish to receive recognition without expecting any economic return. Some expect companies to discover their abilities, so they continue to help the community modify the software (Raymond, 1999; Lerner and Tirole, 2002). In a firm-hosted musical software community, users generally appreciate the product, the firm and the developers. The users participate because they feel pride when the firm recognizes their contributions. This also explains why they freely reveal their innovations to the public (Jeppesen and Frederiksen, 2006).

Though the motives for product development of user innovators who innovate alone are not deeply explored, we expect that their motives may be different from community users as they do not have peer pressure or outside stimuli as much as

community users who continuously observe other people's development and contribution to communities. This leads to our next hypothesis:

H4: The types of user innovators are independent with motives for product development.

Methodology

Data collection

The surveys were conducted online in Japan with the assistance of Borders Inc., a Japanese market research company. An electronic questionnaire was sent to panel consumers aged 18 and up. The survey was conducted from September 1 to September 16, 2010. Questionnaires were sent to 87,439 people in Japan, and I received valid responses from 21,027 subjects in Japan (response rate: 24.05%).

Questionnaire

The questionnaire comprised three parts. In the first part, I asked all respondents to provide demographic information (gender, age, employment status, education type and level of educational attainment).

In the second part, respondents were asked whether or not they had created or modified a product in the three years prior to the survey. If yes, the respondents were asked to indicate the type of product created or modified, and to describe their creation or modification in a free-format narrative text.

The third part involved only those respondents who had actually created or modified a product in the three years prior to the survey. I asked about innovation costs, community membership, assistance received, information revealed, their motives for developing products, and their motives for sharing information. I also asked whether they were aware of any others who had adopted their innovations. If yes, they were asked

about compensation. Full questionnaire can be referred from Appendix B.

Sample reduction

In order to select user innovators, I purged the sample in two steps. First, I used screening questions to eliminate responses that did not qualify as user innovations (i.e. highly original and innovative creations/modifications). I tested originality by asking respondents whether they knew of others who had developed an equivalent “home-made” product, or if they knew of an equivalent product available on the market. Respondents who replied “yes” were excluded from the sample. With regard to innovativeness, I asked whether or not the creation or modification exceeded the existing product’s functionality. In cases where the functionality of the creation/modification did not go beyond that of the existing product, or where innovativeness was less than 10% compared to the existing product, I eliminated the respondent from our sample. A total of 79.1% (N=405) of all purported innovations (N=512) were discarded in this first step of the reduction process.

The next step was to appraise the free-format descriptions in the remaining responses. Three members of the research team examined and discussed these descriptive responses. Only those cases which were regarded as truly novel and innovative were selected. In the process, I rejected a number of responses that lacked novelty, such as “*I created a tutorial book for driving a crane. I added some pictures for better understanding.*”, as well as other job-related responses such as “*I created a website customization program. My client asked me to create a web site that even beginners can modify by themselves.*”. In the end, I eliminated 50.0% (N=24) of the remaining sample. Thus, only about 29.3% of the reported examples were found to be actual innovations by our standards, yielding a sample of 585 validated cases of innovation by Japanese consumers. Among those cases, 290 respondents were “product

creators” and 400 were “product modifiers”. A total of 105 respondents had both developed and modified a product.

List of variables

In order to explore the similarities and the differences between community innovators and solo innovators, behavioral variables and motives for product development are tested (see Table 4-1 and Table 4-2).

Table 4-1: Behavioral variables about product creation/modification

Variables	Description	Value
IPR	Whether or not the respondents’ apply intellectual property rights to protect the product creation (e.g. patents, trademarks)	1. Yes 2. No 3. Don't know
Information revealing	Whether or not the respondents shared the details of this creation with other consumers or firms	1. Yes 2. No 3. Don't know
Innovation Adoption	Whether or not other people or organizations pick up, adopt or copy the respondents’ creation or modification	1. Yes 2. No 3. Don't know
Receiving Compensation	In case the respondents’ innovation was developed, whether or not the respondents received any compensation	1. Yes 2. No 3. Don't know
Community belonging	Whether or not the respondents belong to a hobby club or a community with a special interest in the type of product they created or modified	1. Yes 2. No 3. Don't know
Receiving assistance	Whether or not the respondents develop the product creation with the help of others	1. Yes 2. No 3. Don't know

Table 4-2: Motives for product development

Variables	Description	Value
Necessity	Because the respondents needed that creation or modification	1: Yes 2: No
Enjoyment	Because the respondents enjoyed doing the creation or modification	1: Yes 2: No
Skill development	Because the respondents wanted to learn or develop their skills	1: Yes 2: No
Altruism	Because the respondents wanted to help someone else via the item created	1: Yes 2: No
Reputation	Because the respondents wanted to improve my reputation or gain respect.	1: Yes 2: No
Cost saving	Because it was less costly than purchasing the product in the market.	1: Yes 2: No
Unfulfilled need	Because the firms or other people could not reach the respondents' needs	1: Yes 2: No

Results

Overview

Table 4-3 shows that less than 15% of consumer innovators belong to communities and receive assistance during product development. However, more than half revealed their creations or modifications to others.

Regarding with motives for product development, most consumer innovators tend to select necessity, enjoyment, and cost saving as their primary reasons in developing products.

Table 4-3: Summary of frequency of respondents by each variable

Variables (n = 585)	Yes	No	Don't know
<i>Behavioral variables</i>			
Community belonging	7.4%	91.3%	1.4%
Receiving assistance	12.0%	86.5%	1.5%
Innovation Adoption	12.1%	63.2%	24.6%
Information Revealing	64.3%	33.0%	2.7%
Receiving compensation (n = 71)	26.8%	71.8%	1.4%
<i>Motivation for Product Development</i>			
Necessity	54.2%	45.8%	-
Enjoyment	36.2%	63.8%	-
Skill development	13.5%	86.5%	-
Altruism	8.5%	91.5%	-
Reputation	3.1%	96.9%	-
Cost saving	31.3%	68.7%	-
Unfulfilled need	10.3%	89.7%	-

Community innovators and product categories

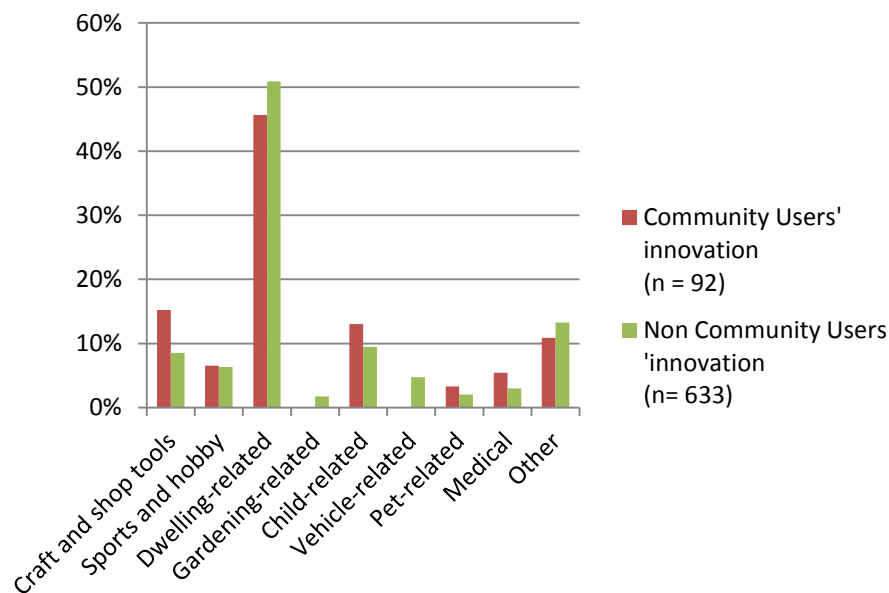
First, I assigned the respondents' open-ended responses to categories using the same classification as in the consumer innovation survey in the United Kingdom (von Hippel et al., 2010). As shown in Figure 1, there are user innovators in every product category in Japan.

Next, using the question "Do you belong to a hobby club or community with a special interest in the type of product you created?", we grouped users who replied "Yes" and labeled them "*community innovators*"; 7.4% of the remaining respondents ($n=43$) were assigned to this group. On the other hand, those who replied "No" were classified as "*solo innovators*". A total of 91.3% ($n=534$) of users were assigned to this category. Eight respondents replied "Don't know" and were this omitted from further analysis. We found that community users exist in almost every product category, except for products related to gardening and motor vehicles.

Figure 4-1 summarizes the categories of innovations which users developed or modified. In general, both community innovators and solo innovators who developed

dwelling-related products represent the largest of the nine categories (46% and 51%, respectively). Solo innovators exist in every product category whereas community innovators exist in all categories except for gardening-related and vehicle-related categories.

Figure 4-2: Percentage of User Innovators in Nine Product Categories



Note: Some users reported more than one innovation. The total number of innovations came to 725.

Most community innovators tend to develop dwelling -related products (46%), craft and shop tools (15%), and child-related products (13%). “Others” refer to innovations that cannot be assigned to one of these eight categories (e.g. software).

Characteristics of user innovators

Table 4-4 shows that 12% (n=70) of user innovators received help from others during the product development process, and that 12.1% (n=71) of user innovations were adopted or copied by organizations or other people.

Table 4-4: Percentage of Affirmative Responses to Characteristics of User

Innovators

Question (n = 585)	Yes (N)
Do you belong to a hobby club or community with a special interest in the type of product you created?	7.4% (43)
Did you develop the product with the help of others?	12% (70)
Did you share the details of this product with other consumers or firms?	57.4% (376)
Did other people or organizations take up, adopt or copy your creation?	12.1% (71)

Next, I used chi-square analysis to investigate the relationship between community membership and activities related to innovation because all the variables (community belonging, information sharing, the adoption of innovation) are categorical variables and chi-square method is suitable in analyzing the relationship between two variables.

Table 4-5 clearly demonstrates that there was a significant association between the community membership and the assistance from others ($\chi^2(1) = 44.19, p < .001$). Users who belong to communities tend to receive help from other people more often than users who do not belong to a community.

Table 4-5: Relationship between Community Membership and Assistance from Others

	Received help from others	Did not receive help from others	Total
Community innovators	19	24	43
Solo innovators	51	478	529
Total	70	502	572

Note: $n = 572, \chi^2(1) = 44.19, p < .001$.

Moreover, the chi-square analysis result shows that there was a significant association between community membership and information sharing behavior. Compared to non-community innovators, community innovators tend more to share their details with others ($\chi^2(1) = 9.77, p < .001$), and their innovations tend to be accepted by organizations or copied by other people ($\chi^2(1) = 28.19, p < .001$). Tables 6 and 7 summarize the relevant results.

Upon closer examination, we can see that 88.1% (n= 37) of community innovators shared details on their creations, while only 64.4% (n=336) of non-community users shared information with other people or organizations.

Table 4-6: Relationship between Community Membership and Sharing of Innovations

	Shared details	Did not share details	Total
Community innovators	37	5	42
Solo innovators	336	186	522
Total	373	191	564

Note: n = 564, $\chi^2(1) = 9.77, p < .001$.

Table 4-7: Relationship between Community Membership and Adoption of Innovations by Others

	Innovation adopted	Innovation not adopted	Total
Community innovators	16	17	33
Solo innovators	54	352	406
Total	70	369	439

Note: n = 439, $\chi^2(1) = 28.19, p < .001$.

As shown in Table 4-7, approximately 48.5% of community innovators' innovations were adopted or copied by others (n =16). I also asked the users whether

they had received any compensation for their creations. 62.5% (n=10) replied “Yes”, while the others (37.5%; n=6) had revealed their innovation at no charge.

Community users and their motives for product development

I next consider the motives of users in their product creation or modification efforts. In the questionnaire, I used a multiple-choice question comprising seven motives to ask users to report the reasons why they had created or modified products (see Table 4-8).

The motives that community users rated highest are necessity (60.5%), enjoyment (55.8%) and skill improvement (34.9%). Non-community users also rated necessity and enjoyment the highest; saving money (31.8%) was also an important motive in this group. Community users and non-community users showed significant differences in the “HELP” motive (I wanted to help someone else): 18.6% of community users report that they innovated because they wanted to help others, while only 8.7% of non-community users indicated this motive.

Table 4- 8: Innovation Motives and Number of Responses

I created/modified a product because . . .	Community Innovators (n = 43)	Solo Innovators (n = 534)	<i>p-value</i>
I needed it myself.	60.5% (26)	53.7% (287)	0.395
I enjoyed doing it.	55.8% (24)	34.6% (185)	0.005***
I wanted to learn or develop my skills.	34.9% (15)	12.0% (64)	0.000***
I wanted to help someone else with the item created.	18.6% (8)	7.9% (42)	0.016***
I wanted to improve my reputation or gain respect.	9.3% (4)	2.6% (14)	0.015***
It was less expensive than purchasing an existing market product.	23.3% (10)	31.8% (170)	0.243
Firms or others could not fulfill my needs.	9.3% (4)	10.5% (56)	0.807

** p < .05; *** p < .01

In the examination of the relationship between community membership and innovation motives, chi-square test of independence was applied as all of the variables are categorical variables. The p-value in Table 4-8 shows the significant level of the relationship. The tests indicate that there were significant associations between community memberships and the following motives: Enjoyment, Skill improvement, Altruism, and Helping others.

Community users are likely to develop innovation because they enjoy doing it ($\chi^2(1) = 7.72$ ($p = 0.005$), they want to improve their skills ($\chi^2(1) = 17.66$, $p = 0.000$), they want to help others ($\chi^2(1) = 5.80$ $p = 0.016$), and they want to gain respect ($\chi^2(1) = 5.88$ ($p = 0.015$).

Community innovators tended to report different motives for product creation or modification efforts than solo innovators, as well. While respondents in both groups reported taking on development activities out of necessity, because no existing products could meet their needs, community innovators tended to identify a broader range of motives beyond need (Table 4-8). They told us that they developed innovations because they enjoyed doing so or because they wanted to improve their skills, help others, and gain respect.

Discussion

Previous user innovation studies have found that user innovators are a significant and promising source of ideas for firms. Innovators who belong to communities are viewed as a specific type of user innovators that share similar interest and innovate together. However, by comparing these community innovators with innovators who do not belong to communities, I found significant differences between both types of user innovators.

Community innovators and solo innovators are demographically similar and report similar levels of self-reported innovativeness and originality. However, significant differences between the groups' characteristics and motives for innovation exist. Compared to solo innovators, community innovators tend to receive assistance from others in the development process and tend to share information with others or firms. These characteristics affect the diffusion and adoption of innovation.

Previous studies have presented similar findings, but I confirmed that these characteristics exist in general consumer products, and not just in specific market categories such as software and sports. Furthermore, community innovators' products tend to be adopted or copied by other users and firms more often than those of solo innovators. Thus, communities represent a potentially valuable source of innovation for firms.

Every company seeks to staff its R&D department with talented inventors with a passion for the brand and its products, a stream of new ideas, and the ability to provide unbiased feedback on product ideas. Our study indicates that community innovators can be those ideal figures.

The participation of the community in the innovation process offers other advantages for practitioners. The community's reaction to an innovation can help firms predict the market size and commercial attractiveness of user innovations. An innovation with a high level of attention from other members is more likely to be welcomed in the market as well. Ultimately, it is far less risky to commercialize a product that is already approved by community members in the relevant market. An independent innovator's innovation may be unique and attractive, but its success in the market is more difficult to predict.

Communities also serve as a sustainable source of ideas. This research shows that user innovators as a group innovate once a year on average. Solo innovators are

limited, by time and other resources, to one or two innovations per year. However, given the number of users in a community, although each user might develop a new product or idea only infrequently, there is a high possibility that someone in the group is engaged in developing an innovation at any given time, particularly in very active communities.

If community innovators are properly motivated, they will enthusiastically collaborate with firms in exploring new ideas and developing innovative products that customers want. Recall that from the survey, community innovators have other motivations apart from necessity such as enjoyment and skill learning. Companies may use some mechanisms to motivate these innovators for collaboration. Users in brand communities such as Lego and Nike are likely to be motivated to participate and reveal their innovation by a wish to be recognized by the firms.

“S-college” project is another example of motivating the innovators. This project challenged Japanese students to develop new products for Kit Kat. The project website was established and participants could post and discussed their ideas on the site. From a conversation with consumers invited to the web platform, students design a new product based on the consumers’ voice and feedback. In the end, the winner team will actually work with the Nestle professional marketing team. From this case, students are motivated to create new product by skill (knowledge) development and enjoyment.

In conclusion, existing user innovation studies have found that user innovators develop significant innovation in various fields and are potential source of innovation for firms. This research finds that significant differences between the groups’ characteristics and motives for innovation affect the diffusion and adoption of innovation. Community innovators’ innovation tends to be adopted in a higher rate than solo innovators. Moreover, they are willing to reveal their innovation.

It would be ideal if the company’s R&D department comprises talented members from worldwide who passionately develop products, often come up with new

ideas, and relentlessly provide unbiased feedback to the company. This research indicates that community innovators are those ideal figures. If they are properly motivated, they will reveal their talent and enthusiastically collaborate with firms in exploring new potential and developing innovative products that the market desires.

Conclusion

User innovators create several significant innovations in various fields. Past research considers community users similar to other user innovators. However, this research divides user innovators into two groups—community innovators and solo innovators. This provides a better insight into the similarities and the differences between both groups.

Both types of innovators have similar demographic backgrounds. Nevertheless, community innovators have some different actions. They tend to share information and help one another than solo innovators. Their innovation tends to be adopted higher than those of solo innovators. This implies that communities can be a valuable source of innovation for firms looking for new ideas.

Moreover, prior research shows that user innovators create products because they need it. This study found that community innovators innovated not only because of necessity. They tend to hold other motivations such as enjoyment and skill development.

These findings raise awareness that to understand user innovators better, researchers should be careful when designing a research. The difference in the status of community belonging can lead to differences in users' behaviors, rate of adoption, and motivations.

Chapter 5

User-driven Innovation Program in Denmark:

The First Attempt of the National Support on Users

I: Introduction

Growing number of research shows that a significant number of users create or modify products for their own use and their innovation is widely adopted by others. Significant innovations in various fields such as medical, banking service and scientific equipment are innovated by users (Lettl, et al., 2006; Olivera and von Hippel, 2009; von Hippel, 1986). Moreover, collaboration with user innovators yields commercial success for a number of companies such as Muji, Nike, and Lego (Ogawa and Piller, 2006; Fuller, 2007; Antorini et al., 2012). Some user innovators establish their own companies as their innovation became widely adopted and gained popularity (Shah and Tripsas, 2007). These evidences well attest users' capabilities in innovation and their contribution to the society.

However, there are some market failures and network failures that lessen users' opportunities in innovating and revealing their innovation. For example, users know their own need well but they do not have skill to innovate or the cost is too high (von Hippel and de Jong, 2010). Existing legitimacy also hinders user innovation. Some users cannot modify existing technology or commercial products as they will violate the patent rights (von Hippel, 2005).

Moreover, the system that motivates user innovators to reveal innovation does not exist. From Chapter 3, the national surveys in Japan and the U.S. show that less than 20 percent of users revealed their innovation. This freely revealing information action is

significant as it prevents overlapped innovation by other users and others can improve the innovation. User innovators improve social welfare but they still encounter with barriers from laws and lack of infrastructure. Thus, public intervention is significant in mitigating these failures.

User innovation researchers suggest several recommendations for policymakers. The government should provide user-friendly environment for innovation such as the R&D tax credit provision and platforms where users can communicate and share their ideas with one another. Regarding with legitimacy, the support of creative common right and open license will protect user innovators from the law violation. However, none of the countries have implemented these ideas yet.

Denmark is the first country whose national policy has attempted to shed light on users. In 2005, the Danish government decided that User-Driven Innovation (UDI) should be targeted for support and listed it as one of the strategic initiatives in their innovation policy. Since 2007, the program has focused on supporting firms and research institutions in studying users or collaborating more with users. The Danish UDI program could be a new model, with implications for both researchers and policymakers for new user innovation supported public policies. However, there have been no studies to date exploring this subject. Using qualitative interviews and desk analysis, this study attempts to investigate the background, the implementation, and the result of the Danish user-driven innovation program. Then, how user innovation is supported will be analyzed.

II: Literature Review

Growing importance of users

Producer innovators are those who innovate because they expect benefits from

selling a product or service. So far, the policymakers perceive that producers are the main innovators in the innovation system. Early frameworks for innovation development, including the relationship to the economy, have been linear models (Godin, 2006) in which basic science created applied science and research, based upon which manufacturers created products and diffused them into the market. Firms' developments in basic science and strengthening technological capabilities have been factors in successful innovation development.

Since the mid-1960s, a growing number of empirical studies have focused on market needs as a source and success factor for innovation (Myers and Marquis, 1969; Rothwell, et al., 1974; Utterback, 1974). The SAPPHO project has compared successful and unsuccessful innovations and demonstrated the importance of user focus in success (Rothwell et al., 1974). Myers and Marquis (1969) found that 21 percent of successful innovations resulted from technical opportunity, whereas 45 percent resulted from demand recognition. The growing awareness of the importance of users' needs, the roles of users have gradually changed their perception from simply passive consumers to being a source of innovation, collaborators during innovation development, and even innovators.

A considerable amount of theoretical and empirical research shows that users also develop products for their own use and user innovators can be found in a wide range of industrial and consumer products including Printed circuit CAD software (Urban and von Hippel, 1988), Library information systems (Morrison et al., 2000), Outdoor consumer products (Luthje, 2004) and Banking services (von Hippel and Oliveira, 2009). These users are defined as *user innovators*, which refer to those who innovate because they expect the benefits from *using* a product.

Several national surveys find that user innovators exist in every country, with 15% to 48% of manufacturers developing products for their own use and with 3-8% of consumers innovated. Table 5-1 shows the results of the national surveys in Canada, the Netherlands, the United Kingdom, Japan, the United States, and Korea.

Table 5-5: User innovation in a national survey

Country	Year of survey	Samples	Frequency	Information Revealing
Canada (Gault and von Hippel, 2009)	2007	6,478 Specific advanced manufacturing technologies companies	43%	17.2% (Modified technology) 19.0% (Developed technology)
Netherlands (de Jong and von Hippel, 2008)	2007	498 Hi-technology small and medium sized firms (1–100 employees)	54%	25%
Netherlands (de Jong and von Hippel, 2008)	2008	2,416 Dutch small and medium sized firms (1–100 employees)	21%	-
Korea (Kim and Kim 2010)	2008	370 manufacturing firms with more than 10 employees	17.7%	3.2%
United Kingdom (Flowers et al., 2010)	2009	1,004 small and medium sized firms (10–250 employees)	15%	-
United Kingdom (Flowers et al., 2010)	2009	2,019 individual end consumers	8%	4.8%

Country	Year of survey	Samples	Frequency	Information Revealing
Japan (Ogawa and Pongtanaalert, 2011)	2011	2,000 individual end consumers	3.7%	10.8%
United States (Ogawa and Pongtanaalert, 2011)	2010	2,000 individual end consumers	5.2%	18.4%

User innovation and social welfare

User innovation can enhance the social welfare because of user innovators' characteristics (von Hippel, 2005). First of all, user innovators are willing to freely reveal their innovation. The national surveys in Table 5-1 show that most users are willing to reveal their innovation for free. In case of manufacturers, approximately 3.2% to 25% of manufacturers revealed their innovation to their suppliers or customers. Moreover, approximately 5 to 18% of consumer innovators revealed their creation. In Japan, all of the consumer innovators are willing to reveal information for free.

This free revealing action is important as it decreases the deadweight loss in the society (Henkel and von Hippel, 2005). In general, producer innovators tend to protect their innovation and limit the access to the innovation only to specific number of people¹³. Other innovators are not allowed to use the innovation or technology; or they have to pay fee. Thus, the deadweight loss occurs as producers sell the goods at the price above the marginal cost of the product.

In contrast, user innovation reduces the deadweight loss in the society as users

¹³ Those who benefit from producer innovators' are customers and the company itself.

freely reveal their innovation. Anybody can access and use this innovation. The innovation adopters bear only the cost of adoption such as development cost. The total welfare of the society with open innovation thus is higher than the welfare of the closed-innovation society.

The second characteristic of user innovators is the understanding of their own needs. While producer innovators know about techniques and know-how, they lack the need-related information. As a result, producers need to invest resource in understanding and exploring users' needs when designing the products. In contrast, users know their problems and develop products to satisfy their own needs. Thus, user innovators can reduce producers' cost of collecting need-related information and mitigate this information asymmetry by providing producers their innovation or information.

Moreover, user innovation can complement producer's innovation. Producers will develop products that serve general consumers' need as much as possible as producers need to make profit from selling. However, some minor groups of users' need may not be fulfilled. User innovators will bridge this gap by providing solutions that improve or complement the producers' innovation (Henkel and von Hippel, 2005; de Jong, 2010). Other users who share similar need will gain benefits from the user innovation. Producers will also receive ideas to improve their products and launch other models which can fulfill customers' need better.

Market Failure, System Failure, and the Implications for Policymakers

As explained above, user innovators' expected benefit from innovation and revealing behavior are different from producer innovators'. User innovation also enhances the social welfare and reduces the deadweight loss. However, user innovators encounter with some difficulties in innovation and also require public intervention. This

section reviews literature about public intervention from two aspects—neoclassical economic view of market failure and evolutionary economic view of system failure in both producer-centered paradigm and user-centered paradigm. Then, implications for policymakers from the aspect of user innovation researchers are discussed.

Market Failure

Neoclassical economists assume that all economic agents have perfect information about different options. However, in a perfect competition, possible market failure to achieve parent optimal is caused when markets under-invest in resource allocation (including R&D activities) (Nelson, 1959; Arrow, 1962). Classical reasons of market failure are market inappropriability, uncertainty, indivisibility, and asymmetric information.

First, inappropriability refers to firms' lacking ability to fully appropriate the benefits from innovation (Chaminade and Edquist, 2006; Gustafsson and Autio, 2006). In a producer-centered paradigm, innovators may underinvest in innovation activities because they view that their competitors or imitators may benefit more than the first innovator. In comparison, user innovators do not encounter with the lack of appropriation as they directly benefit from their innovation which derives from necessity.

Second, uncertainty relates to producers' inability to know the outcome and the related risk in advance. When producers have to make a decision on R&D inputs, they may underinvest the resource in innovation processes. Policymakers may alleviate this uncertainty via various forms such as coinsurance and cost-plus contract, which is suitable for highly uncertain cost (Arrow, 1962). Comparing with producers, user innovators may not suffer with uncertainty much as they know their need and the expected outcome. They may have only technical uncertainty as some may not know

technology that can solve their problems (von Hippel, 1994).

Third, indivisibility implies that as new innovation is created from existing technology or knowledge, it is difficult to separate. Producers need to invest substantial money to create innovation (Chaminade and Edquist, 2006). User innovators also encounter the problem of indivisibility. If the innovation cost is too high, users may not be able to afford and do not innovate. von Hippel and de Jong (2010) suggests that policymakers can alleviate the failure of indivisibility by facilitating modular designs of innovation. The government may provide public investment in creating modular design in specific fields so users can develop or modify each part independently in lower cost.

Fourth, information asymmetry refers to the situation that one party has more or better information than the other. Thus, significant innovation may not be developed. In user-centered paradigm, producers have better knowledge in designing and marketing innovations. On the other hand, users have better information about their own needs but they may not know the solution information (von Hippel, 1994; Ogawa, 1998). Public intervention may occur in the form of improving producer-user interaction (von Hippel and de Jong, 2010). The government may launch informational campaigns or consultancy services about user innovators' potential and encourage producers to collaborate with those users.

System Failure

The neoclassical approach of market failure provides policymakers basic understanding about knowledge and basic science. However, this approach has shortcomings in explaining innovation activities that are growing in complexity and involving with several partners. It became difficult to identify or define market failure (Hauknes and Nordgren, 1999).

In 1980s, the new approach called system innovation approach was created based on evolutionary theory (Nelson and Winter, 1982; Lundvall, 1992; Freeman, 1995). The basic concept is that innovation is not created by single agent but by the interaction among different actors in the system such as universities and research centers. The system failure occurs when the combination of mechanisms are not operated well. There are four main systemic problems: capability failure, network failure, institutional failure, and framework failure.

First, capability failure refers to the phenomenon that producers lack capabilities to learn rapidly and effectively. Thus, they cannot adopt new technology or innovation. Users also have similar problems. They may not have enough knowledge, skill, or resource to innovate (von Hippel and de Jong, 2010). Policymakers may increase users' capabilities via education and training. For example, skills that are significant for innovation processes such as a problem-solving skill and basic technical skill should be taught in an education system. As a result, users will have enough skills to overcome capability failures and innovate.

Second, network failure (or interaction failure) rises when actors in the system have too much or too little interaction. For example, actors fail to assist one another with required information as the actor who serves as a bridging role does not act well (Woolthuis et al., 2005). In user-centered paradigm, empirical studies show that user innovators generally reveal their innovation only to members in their close networks (de Jong and von Hippel, 2008). Consumer innovators surveys in Japan and the United States also finds similar findings (Ogawa and Pongtanalert, 2011). Less than 20 percent of consumers revealed their innovation. Valuable user innovation may not be shared to the society.

Policymakers can strengthen this user sharing network by providing systems which supports free revealing of single user innovators such as idea contests and platform provision (Baldwin and von Hippel, 2009; Gault and von Hippel, 2009). For industrial products, the government may stimulate networks and collaborations between user firms and producers (suppliers) (Kim and Kim, 2010).

Third, institutional failure refers to failures in the framework of regulation and legal system which hinder innovation. Some existing legal systems may discourage user innovators from changing or improving commercial product for their own use (von Hippel, 2005). For example, as the Digital Millennium Copyright Act does not allow illegally copying software and cracking code, users are not able to modify the commercial software products.

To overcome institutional failure for user innovators, the government may provide the infrastructure or system that enables users to modify and use existing technology for their own use easier. Examples include open patent, creative commons, and open licensing (Baldwin and von Hippel, 2009; Gault and von Hippel, 2009; von Hippel, 2005). Moreover, R&D tax credit for user innovators who freely share their innovation may encourage more users to reveal their innovation (Baldwin and von Hippel, 2009; Gault and von Hippel, 2009).

Fourth, infrastructural failure based on the failure or under-developed infrastructure in the innovation system. The infrastructure includes physical infrastructure such as IT, transportation as well as scientific infrastructure such as laboratories and technical institution (Chaminade and Edquist, 2005). One significant failure in user innovation paradigm is that current policymakers still consider producers as innovators (von Hippel and de Jong, 2010). Thus, most supports and measurement are

for producer innovators.

Government should consider users as significant innovators and provide infrastructure supports so that users can innovate easier and more efficiently. One example is to provide wide internet access so that users can communicate with other users and reveal their innovation better. Some basic technologies such as internet system and software are significant for user innovators. Policymakers may provide financial support to these system and software providers (Kim and Kim, 2010). Table 5-2 and Table 5-3 summarize the market failure and the system failure in both producer-centered paradigm and user-centered paradigm.

Table 5-6: The Market Failure in Producer Innovation Paradigm and User Innovation Paradigm

Reasons of Market Failure	Producer Innovation		User Innovation	
	Characteristics	Policy Implications	Characteristics	Policy Implications
<i>Inappropriability</i>	Unable to appropriate the benefits from invention		Less problematic than producers	
<i>Uncertainty</i>	Impossibility to know the outcome and risks of innovation	Co-insurance, Cost-plus contract (Arrow, 1962)	Less problematic than producers	
<i>Indivisibility</i>	Minimum scale of knowledge required for new innovation			Modular design facilitation (von Hippel and de Jong, 2010)
<i>Asymmetric Information</i>	One party has better information than others			Producer adoption campaigns (von Hippel and de Jong, 2010)

Table 5-3: The System Failure in Producer Innovation Paradigm and User Innovation Paradigm

Reasons of System Failure	Producer Innovation		User Innovation	
	Characteristics	Policy Implications	Characteristics	Policy Implications
<i>Capability Failure</i>	Firms' lacking competences, capacity or resources	Provision of knowledge inputs (Charminades and Edquist, 2005)		Training, Education (von Hippel and de Jong, 2010)
<i>Network Failure</i>	Too much or too little interaction that leads to systematic failure	Networking and interactive learning between different organizations (Charminades and Edquist, 2005)	User innovators reveal their innovation only to members in their close networks.	• Systems supporting free revealing of single user innovators (Baldwin and von Hippel, 2009) • Collaborative project sponsor (Baldwin and von Hippel, 2009; Gault and von Hippel, 2009) • Strengthening networks between user firms and suppliers (Kim and Kim, 2010)
<i>Institutional Failure</i>	Institutional mechanisms that may hinder innovation such as IPR and social values	Provision (creation, change, abolition) of institutions (Charminades and Edquist, 2005)	Policymakers still do not aware users' capabilities of innovation	• Open licensing infrastructure (Baldwin and von Hippel, 2009; Gault and von Hippel, 2009) • R&D tax credit for user innovators who freely reveal (Baldwin and von Hippel, 2009; Gault and von Hippel,

Reasons of System Failure	Producer Innovation		User Innovation	
	Characteristics	Policy Implications	Characteristics	Policy Implications
				2009) • Open patent (Baldwin and von Hippel, 2009)
<i>Framework/Infrastructural Failure</i>	Failures regarding with insufficiency or inefficient infrastructure, accommodation, transportation, or systems	• Incubating activities and provision of consultancy services (Charminades and Edquist, 2005) • Financial support (Charminades and Edquist, 2005)	Most public intervention focuses on producers.	• Lower communication cost (Baldwin and von Hippel, 2009) • Financial support to system and software providers (Kim and Kim, 2010)

III: Methodology

To construct this study, I collected data from government publications. Because most of the publications are in Danish, I used the Gramtrans program to translate Danish into English. The secondary data provides basic information about the concept of the program, the government vision and policies, the amount of fund, and the project selection criteria.

However, the data about the background of the program and the detail of each funded project, the outcome of the program, and the satisfaction of project participants were lacking. For further insight, I conducted semi structured interviews 45 times from June 6 to 10, 2009, August 9 to September 8, 2009, July 5 to 13, 2010, and March 17 to 25, 2014. Each interview took approximately one hour. Among those interviewed were Danish policymakers, program participants, and experts on UDI and innovation policy.

I contacted Danish policymakers who have been in charge of the UDI program. I interviewed 14 policymakers in total, which include staff members¹⁴ from the FORA Division for research and analysis¹⁵, staff members from the Danish Enterprise and Construction Authority (DEACA), and one staff member from the Danish Council for Strategic Research (DCSR). Twenty-one program participants, all of whom are project managers or persons in charge, also cooperated in this survey. Finally, 10 experts in innovation policy and UDI also participated.

The interviews can be chronologically divided into four times as follows:

¹⁴ One of the staff members did not work at FORA after the interview.

¹⁵ The institution first created the term “User-driven innovation” and served as an important contributor of the UDI program.

I) June 7 to June 9, 2009

UDI was implemented during 2007 to 2010. In this period, the government just provided fund to projects. I contacted 2 policymakers, 1 project manager, and 3 academicians in UDI field. The selection of interviewees was by snow ball method.

For policymakers, the interviews were mainly about the background of UDI program, how the government decided to launch this program, and the implementation of UDI program. For the project manager, the questions were related with her motivation in participating this program, the project detail, and the difficulties or problems about project participation. For academician, I asked about their opinions towards UDI program. The interview questions are included in Appendix C.

II) August 13 to September 7, 2009

In this period, 6 policymakers, 12 project managers, and 6 UDI academicians and professionals were interviewed. I used the same questions as the first period.

III) July 5 to July 9, 2010

In 2010, most of the projects sponsored by the government finished. The aim of the interviews thus focuses on the result of the UDI program and the difficulties that the interviewees encountered. For policymakers, the questions were also about the next step after UDI program. In this period, three policymakers and three project managers were interviewed. The interview questions are included in Appendix C.

IV) March 17 to March 26, 2014

I conducted follow-up interviews. For policymakers, the interviews mainly focused on the new policies after UDI program and the remained effect of UDI program.

For project managers, I interviewed their current activities and whether they still continue UDI related projects or not. Totally, three policymakers, 5 project managers, one consultant firm, which helps provide information for the government, were interviewed. (See Appendix C for interview questions)

Table 5-4 below summarizes all the interviews in four periods and the categories of interviewees.

Table 5-4: Periods of interview and interviewees in the study

Types of Interviewees	I: June 2009	II: Aug-Sep 2009	III: July 2010	IV: March 2014	Total
Policymakers	2	6	3	3	14
Project Managers/Participants	1	12	3	5	21
Academicians/Professionals related to the program	3	6	0	1	10
Total	6	24	6	9	45

IV: Findings

Background of UDI

The UDI concept was first proposed by FORA-- an independent research institution under the Ministry of Economic and Business Affairs. Rosted (2003) deduces from the Community Innovation Survey (CIS) that a number of Danish companies enlist users as an important source of innovation. Nyholm and Langkilde (2003) recommend that in order to strengthen interactions between customers, suppliers, and competitors, policymakers should implement regulations and policies that stimulate cooperation among these players.

These reports by FORA have increased the Danish government's awareness of UDI. In February 2005, the Danish government initiated the strategic plan for Denmark called "New Goal". The plan responds to the growing awareness of the increasing degree of global economic openness and the risk of losing in tough global competition. In April 2006, 350 initiatives for the globalization strategy were identified, with the four focus areas—education, research, entrepreneurship, and innovation—unchanged since the inception of the New Goal. Thirty nine billion Danish Krone were allocated for the globalization fund during 2007–2012.

UDI is one of the plans underpinning the creation of a high entrepreneurship society and belong to two of the five priority areas: R&D and innovation and entrepreneurship. The program for supporting UDI is planned to stimulate collaboration between companies and educational institutions in order to clarify market needs and create related competences. The network among technical schools and business colleges is also planned to develop as a center of knowledge for companies in the regional areas (Regeringen, 2005).

The Concept of UDI

The Danish Ministry of Economic and Business Affairs defines "User-driven innovation" as "a systematic approach to the development of new products, services, processes, forms of organization, etc. based on the exploration or involvement of users' lives, identity, practice, or needs, including unrecognized needs that are expected to materialize later as demand from major user segments." (Danish Enterprise and Construction Authority, 2007). Users include consumers, customers, employees, enterprises, collaborating partners, suppliers, or citizens.

At the beginning, user is perceived as being observed and studied by firms and

researchers during the design and research and development process. Users do not acknowledge his own need and does not participate in firms' innovation process. Reports by FORA such as Rosted (2003) and Hogenhaven (2005) basically introduce the idea of user with unacknowledged needs. This suggestion generates from their visit trip to the U.S. and the examination of a number of successful cases, mostly from North America (Jensen, 2012). As users do not know what they want, firms need to investigate those needs by applying anthropological methods such as observation to understand and collect insights.

Then, the second type of users was mentioned when FORA research team met Eric von Hippel, the user innovation and lead user concept developer, and inserted this approach as another user-driven tool to the reports (Jensen, 2012). Lead users have certain needs and none of the existing products could fulfill so they innovate by themselves. Their innovation is ahead of the market. Firms can collaborate with these lead users in developing new products.

The Danish policymakers did not adopt von Hippel's idea in that some users can develop and freely reveal their innovation. The focus of the program is shifted to only the commercial potential of lead users in providing ideas or innovation to firms (Jensen, 2012). From the interview with the policymaker, the government still regards producers as the main innovators.

“We still believe that firms are the key engine of innovation, and we just want to make more efficient whereas von Hippel is saying the key engine of innovation is that the individual users.

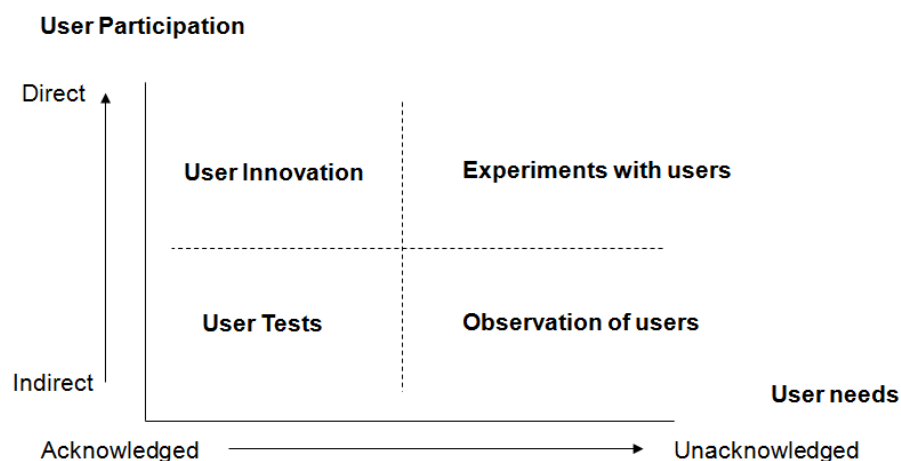
... We're both right that these two things are happening in the world. I think it's like 25% of the programs have more lead users that type of innovation and 75% are more base on this observing what is firm to do."

(Interview with the policymaker, August 19, 2009)

The Ministry of Science, Innovation, and Higher Education proposed the last type of user, participating users (Jensen, 2012). These users do not know their needs but they participate in firms' R&D activities in exploring new commercial opportunities. Experiment with users such as prototype workshops are examples of tools in this UDI approach. This concept reflects Scandinavian tradition for participatory design which originated in the 1970s.

Thus, the term "user" in UDI program is broadly defined, and the roles of users as well as the approaches in UDI processes are various. Figure 5-1 shows three types of users and approaches applied in UDI program.

Figure 5-3: Definition of UDI



Source: Danish Ministry of Economic and Business Affairs (2008), Wise and Høgenhaven (2008), page 28.

The Objective of UDI

According to Danish Enterprise and Construction Authority (2007), the objective of the program is to strengthen user-driven innovation in enterprises and public institutions. The applicants will be evaluated by the selected committee based on the following conditions.

1. The project must be based on user needs.
2. The project must have high novelty value. The novelty may be either new methods or innovative ideas that are different from the traditional approach.
3. The effect must be measurable and lasting.
4. The result of the project must be useful to others.
5. The project participants must disseminate results to others outside the project.
6. The project comprises activities that would not be undertaken to a very limited extent.
7. There must be at least two collaborating partners in a project and that at least one is an enterprise or a public institution.

Implementation of the user-driven innovation program

The UDI program was implemented in 2007 and was divided into two sub programs. The first program under the research and development area is called the UDI research program, and the other, under the innovation and entrepreneurship area, is called the UDI business program.

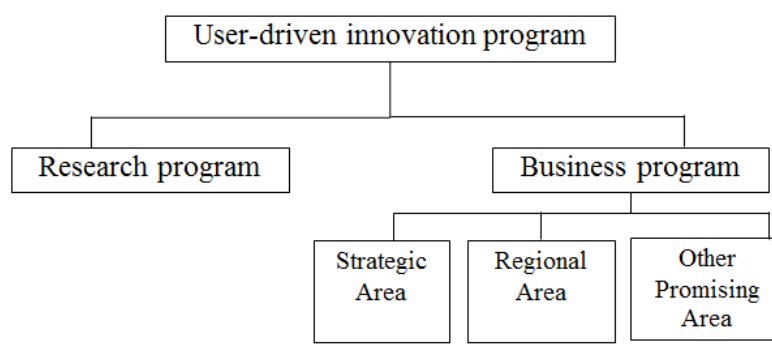
The UDI research program is designed to support knowledge creation for UDI so that companies and other public institutions can implement UDI in the future. The program is also expected to develop a research environment that meets high international

standards (Finansministeriet, 2006). The ministry will provide grants for researchers who aim to conduct a research about UDI or establish the research center.

The types of grant are categorized as research centers, research alliances, and research projects, depending on project period and grant size. Grants for research centers are approximately five million Krone annually, and the project must be in operation for five to seven years. Research alliances' project period is around five years, and the grant size is 10 to 20 million Krone. Research projects are required to last only from 3 to 5 years, and the grant should not exceed 20 million Krone.

On the other hand, the UDI business program aims to strengthen UDI in private companies and the public sector for the development of new products and services. The total amount of grant is 100 million Krone. The fund is allocated to 83 projects within three years. In contrast to the research program, the amount of the grant for the business program is not fully covered because the government wants participants to enthusiastically develop projects, and the participants' own investment in their project motivates that behavior. Grants to the public sector, research institutions, and educational institutions cover 75% of the eligible project's cost, whereas grants to for-profit companies cover 50% of the eligible project's cost. Figure 5-2 shows the structure of the UDI program.

Figure 5-4: The structure of UDI program



The Outcome of the Program

UDI program successfully raised people's awareness towards the significance of involving users in the innovation process (Damvad, 2009). According to the mid-term program evaluation conducted by the Government, 90 percent of participating firms and public organizations had not known the concept and value of user driven innovation before. The program facilitated these participants to learn and experiment new approaches in innovation activities in their organizations (See Appendix D for more detail of each project and the outcome).

Moreover, the program also contributes in knowledge diffusion in the society. The participants in the UDI business projects have to publicize their findings or results through public via forums or conferences. From the qualitative interviews, the project participants report that the number of the participants in these public hearings ranges from 50 to 200 people.

Another outcome is the UDI method diffusion. The government promoted the UDI methods and the significance of users when it called for the applicants for UDI program. UDI methods and concepts were explained on the website. After the program ended, the Ministry of Economic and Business Affairs also publishes *The Handbook of 30 Innovation Methods*, based upon results from 62 UDI business program projects, as a guideline for those who are interested. The online version can be downloaded from the Ministry website.

Some projects also disseminate knowledge about UDI by providing online UDI tools, guidelines and steps in collaborating with users. The case studies and the findings

are also published on the websites¹⁶. As a result, the knowledge and UDI approaches are not limited to only the participants but also other firms or public organizations.

Furthermore, UDI program also facilitate participants with new product idea and user-driven innovation method application. In each project, the Ministry requires two or more organizations participating. The collaboration between companies and universities or companies, public sectors, and research institutions are common in this program. Companies can learn UDI methods from universities or research institutions.

We also develop new methods. We've got some positive attention and new clients.

(Interview with Design People¹⁷, 24th March 2014)

Public sectors such as hospitals and libraries also learn how to involve users in their innovation process from their university or research organization partners. For example, after collaboration with the university, one design company developed a new method which helps developing dialogues with consumers and gaining better insights.

Universities and research institutes also gain benefits from this program. They can study different industries or try new methods. New UDI methods, better UDI tools, and academic papers including books have been developed from the research projects. The research outcome and methods are also applied in the lectures.

This (The UDI program) was really nice and we have so many results, we have the method result, we have the concept results. We're also writing papers about patient innovation. Within the e-health, the clinical wealth, there're many things to say from this.

¹⁶ For example, the Maxi Project (<http://www.maxi-projektet.dk/Home.464.0.html?&L=1>) developed the IT service and application to assist the diabetics and their families. The publications, online tools, and the videos were posted on the website.

¹⁷ Design company which focuses on products for female

In terms of knowledge production, we really learn a lot.

(Interview with Professor Anne Marie Kanstrup,

Aalborg University, 18th March 2014)

The Support of User Innovation

To investigate how far user innovation was supported during UDI program, I first explored the projects that are related with user innovation. Secondary data analysis related with all 74 projects funded in the business program was conducted. I also interviewed 21 project participants about the role of users in their projects.

Users in each project are categorized into two types— user innovators and non-user innovators. *User innovators* are users who have originally developed or modified products that project participants are interested, and actually use those products. These users may be invited to participate in the discussions, workshops or interviews in the projects. The projects that involved these user innovators are categorized as user innovation projects.

On the other hand, *non-user innovators* refer to users who had not developed products or develop service before they participated in the project. They may be observed when project participants apply anthropological methods such as ethnography. They may generate new ideas or create prototypes during the design workshops or interviews; however, they have not innovated products or service related with the workshops before. The projects that involved these non-user innovators are categorized as non-user innovation projects. The projects that cannot be categorized due to lack of information are labeled as unspecified.

There are totally 83 projects granted by the Danish Government. However, nine projects which related with employee-driven innovation were discarded from the study. From the analysis, 10 projects (14%) out of 74 projects utilize user innovation methods. The types of projects are climate-related, digital, experience and other perspective areas such as the establishment of an online community. Table 5-5 summarizes the project categories and whether they are user innovation projects or not.

Table 5-5: The number of user innovation projects and non-user innovation projects divided by categories

Categories ^a	User innovation projects	Non-user innovation projects	Unspecified	Total
Climate	1	3	1	5
Construction	0	4	0	4
Digital	2	2	0	4
Elderly and Disable related	0	5	0	5
Experience (Game, Sports)	1	1	0	2
Public Health	0	4	0	4
Regional	0	14	0	14
Welfare	0	6	0	6
Others	6	16	8	30
Total	10	55	9	74

^a All nine categories were classified by the Danish government.

All user innovation projects are listed in Table 5-6 below. Six out of ten projects are hold by private companies whereas the other four projects were administered by universities. The interesting thing is that Copenhagen Business School and Aarhus Business School serve as a significant knowledge hub of user innovation. I interviewed

seven user innovation project managers and found out that all of them are teaching at or graduated from both schools. They learned the concept of user innovation, the lead user method, and user toolkits from the courses provided at both schools. When the government announced the call for UDI program, they applied because they were eager to implement the user innovation methods.

I have a background from the Copenhagen Business School where I did a Ph.D on strategic alliance so I have a network out there among the researchers and one of the person I know quite well is Lars Bo Jeppesen. So I had knowledge about something is going on with lead users.

(Project manager of User-driven innovation in the gaming industry,

July 8, 2010)

Table 5-6: The Name, the Type of Project Holders, and the Outcome of User innovation Projects in the UDI program

No.	Project Name	Types of Project Holders	Outcome
1	Light and Energy - Lead-user-driven technology development	Company	New products related with light and energy that can lessen CO ²
2	User-driven mobile community	Company	Beta version of mobile browser for social networking
3	Intelligent Utility - Development platform for user-driven service innovation in the energy	Company	Toolkit to understand customers
4	User-driven innovation in the gaming industry: A lead-user model for high-tech entrepreneurial start-ups.	Company	Better educational game software

No.	Project Name	Types of Project Holders	Outcome
5	Active User Topologies	Educational Institute	Methodologies for lead user studies and exploitation (especially for Small and Medium companies)
6	Future Supermarket	Company	New business concepts, strategic and tactical initiatives for supermarkets
7	JOIN: Joint Online Innovation Network	Company	Online community innovation platform where companies, designers and consumers jointly can develop products
8	Lead user-based entrepreneurship	Educational Institute	Open online platform that supports lead users in establishing new companies
9	New Product Development with Lead Users	Educational Institute	- Firms' better understanding customer needs - Academic theory/method test
10	Use Box - using tools and methods for generating innovation	Educational Institute	- Toolbox (web guide) for firms to prepare and innovate with users - Web that firms can use in customizing courses of development to access lead users' knowledge about products and services.

According to Table 5-6, the outcome of user innovation projects is similar to non-user innovation projects. Companies gain new product ideas or prototypes. They also learn and practice how to collaborate with user innovators in the R&D process. Educational institutes gain new knowledge or develop new methods about user innovation.

However, most projects still support producer innovators. The main focus is how to collaborate user innovators in the producers' innovation activities. There are only two projects that directly support user innovators. The first is "Lead user-based entrepreneurship" project which directly supports user innovators who want to launch their own business. The second one is the "JOIN: Joint Online Innovation Network". This project provides community space for users to share their ideas or their needs. Users

will vote one another's ideas and the idea that received the highest votes will be designed and produced.

V: Discussion

Denmark is the first country in the world that attempts to support innovation related with users. The government stimulated collaboration among firms, public sectors, and universities in involving users in the innovation activities by providing grants. The outcome of this program is knowledge diffusion about user-driven innovation, a better understanding of UDI methods, and more application of UDI approaches in various industries.

However, all of the public intervention is still based on producer-centered innovation paradigm. The Ministry did not share user innovation researchers' interest in the conditions under which certain users can develop (Jensen 2012). The analysis suggests that the UDI program was not designed to directly support user innovators' activities. User innovation was simply one of the concepts that the Danish Government believes can be applied for Danish firms' commercial activities.

Although no specific strategies support innovation by users, some activities in this program could alleviate market failure and system failure in user-centered innovation in a certain level. Firstly, the UDI program raises producers' awareness and their interest towards user innovation. Information about the lead user method (von Hippel, 1988; von Hippel, 2005) including examples are introduced on the UDI program's website where project applicants for UDI funding can learn how to implement user innovation methods in their projects. In addition, projects implementing user innovation such as the project called "Lead-user based entrepreneurship" received high-media attention (Damvad, 2009). This generates better understanding of user innovation

among producers and may lead to collaboration in the future.

Secondly, the network among firms which are interested in user innovation and educational institutes was tied. Some large Danish enterprises such as Grundfos and Lego have long collaborated with user innovators in their innovation activities and the network is further strengthened in this program. Moreover, the network between research institutions and start-up enterprises¹⁸, which are new to user innovation, was also created.

Thirdly, open platforms and communities are created. Users can communicate and freely reveal their ideas and innovation easier. One of the projects even supports user innovators who want to establish their own companies. This alleviates the network and structural failure in the system.

This research shows that the mindset of Danish policymakers relies on producer-centered paradigm since the beginning. This reflects in the governmental support and the program design that focuses on producer innovators. In the future, it is significant to convince policymakers about the importance of user innovation. One of the solutions is to collect national data that shows the impact of user innovation and the contribution of user innovators. The governmental support on user innovation such as the lessening R&D tax credits or legislation will not be implemented without the policymakers' clear understanding of user innovation.

Another important factor is the existence of educational institutes that can provide knowledge about user innovation. Educational and research institutions are significant in the system of innovation as they develop new knowledge and diffuse to the society. Moreover, they also serve as an advisor for firms and policymakers. In Denmark, two business schools serve as a core player in diffusing knowledge and training

¹⁸ Examples include the "User-driven innovation in the gaming industry: A lead-user model for high-tech entrepreneurial start-ups" project.

companies. This will help stimulating more adoption of user innovation and collaboration between producers and user innovators. In an ultimate level, academicians at the schools can give advice and help policymakers initiate public intervention that supports user innovation.

VI: Conclusion

Extant research shows that user innovation exists in a significant number in various countries, and is significant in enhancing the social welfare. User innovators decrease the deadweight loss and the monopoly market in the society. Similar to producer innovators, user innovators also encounter with market failure and system failure of innovation such as the lack of systematic support and network creation among users. Public intervention is significant in mitigating these failures.

Until now, policymakers tend to mainly support producers. There is still lacking of awareness about user innovation and its significance. This research aims to collect the data about the Danish user-driven innovation program, which is the first national support on user innovation. However, the analysis shows that most of the implementation and public intervention are still based on producer-centered paradigm. The support is in the form of fund providence to producers, public organizations, research institutions and universities.

Though user innovation was not directly supported, some significant outcome existed. The awareness towards user innovation increased. Collaborations between academic institutions and firms in conducting lead user methods are also observed. From this collaboration, the increasing network effect among participants and the diffusion of user innovation methods can also be seen.

In designing innovation policies in the future, it is important to provide policymakers better understandings of user innovation. Most policymakers get accustomed to producer-innovator paradigm and may misunderstand that user innovation is another way to assist producer innovator to innovate better. Academicians should explain the growing importance of user innovations and the increasing welfare effect in the societies.

Chapter 6

Conclusion

This thesis attempts to clarify the user innovation phenomenon from a wider perspective integrating three sectors—users, firms, and the government. The quantitative and qualitative analyses conducted explored activities by all three sectors. In this chapter, I summarize all these analyses and discuss the potential role for national support of user innovation. Finally, areas for further research will be suggested.

The first paper (Chapter 3) provides an overview of user innovation at the national level. From national surveys conducted in Japan and the United States, significant data such as number and scale of user innovators, the cost of innovation, and demographic data of user innovators were collected. I found that a significant number of user innovators exist in various product categories. The rate of user innovation in Japan is 3.7% and 5.2% in the U.S. Another significant finding is that user innovators tend not to protect their innovations.

Though user innovators are willing to reveal their innovations, this thesis shows that the rate of information revealing and therefore the adoption rates of their innovations are low. Less than 20 percent of user innovators shared their innovation, and less than six percent of users' innovations were adopted by other consumers or firms. These numbers imply that although user innovators are willing to share their innovations, they do not do so unless sufficient motivation exists, such as through positive incentives like financial reward, recognition, and self-development (Fuller, 2007; von Hippel, 2005). User innovators in the surveys did not reveal their innovations because they did not have particular reasons to do so.

In the second paper (Chapter 4), I identify the specific type of user innovator whose innovations are adopted more frequently than those of other user innovators. The key difference is the user innovators' status in terms of belonging to a community. User innovators who belong to communities tend to share their innovations and receive help from other users more often than user innovators who do not belong to any communities related to their innovation. Innovations by community members tend to be adopted more frequently than those of solo innovators. Thus, community innovators serve as a potential source of innovation for firms looking for new ideas.

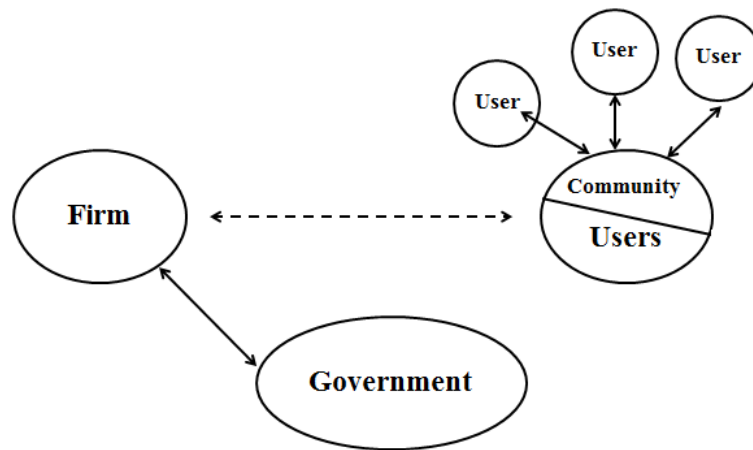
The last paper (Chapter 5) reveals the presence of a gap in user innovation policy between academicians' suggestions and policymakers' actions. The current body of user innovation research suggests that policymakers should provide infrastructure, user-friendly legitimacy, or better environments for user innovation so that users can innovate easily. However, a study of the Danish user-driven innovation program, which is the first program to support users, reveals that even this program is still based on the concept of producers as the main innovators. Policymakers support producers and educational institutions via public funds.

Figure 6-1 summarizes the findings of the three papers contained in this study. First, user innovators generally do not have interactions with firms or governments. Within the government-supported program, user innovators participate in some firms' collaboration projects. However, the number is still rather low. The dashed line indicates this vague relationship between firms and user innovators.

Second, relationships between user innovators themselves are not strong, except among users who belong to communities. Community innovators are active in sharing and helping one another shape their creations. Third, the government has a strong

relationship with firms. They support firms' innovation activities via public funds and knowledge provision.

Figure 6-1: Diagram of existing relationship among three sectors in user innovation



The first step to start supporting user innovation at the national level is the government gaining a clear understanding of the concept and impact of user innovation. This research finds that the Danish government misunderstood the concept of user innovation and therefore implemented a producer-centric paradigm. This resulted in the design of public interventions that allocated all available resources, producers, and educational institutions. As a result, user innovation is not directly supported.

One way to alleviate this problem is to provide the government with knowledge and data about user innovation. The educational sector plays an important role in convincing the government regarding training and innovation support. University researchers should both educate policymakers and pay close attention to the design of public policies.

It is significant that policymakers intervene in stimulating user innovators' innovation as well as information-sharing. This thesis shows that with the exception of

community innovators, the rate of information sharing by user innovators is extremely low. Their creations may be significant but if those innovations are not revealed to society, their benefits will accrue to only a specific number of people. Moreover, other users may create similar items, which results in inefficient resource use.

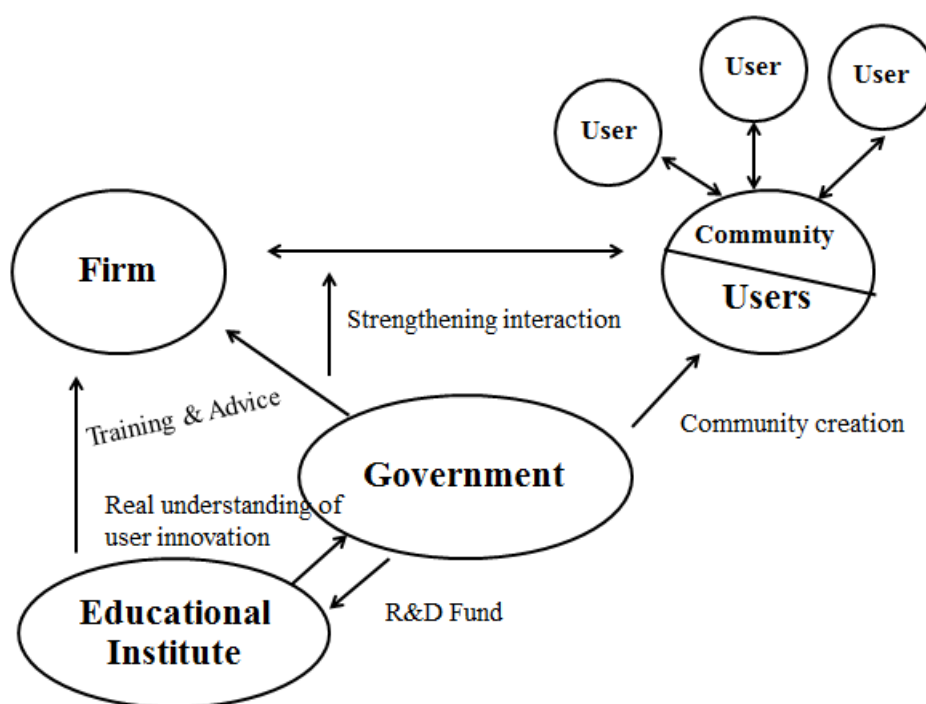
The government can prevent overlapping user innovations and stimulate users to reveal their innovation through various mechanisms. One such approach is to provide platforms or communities for users with common interests, thus enabling them to participate and interact. As this thesis demonstrates, user innovators who belong to communities tend to share their innovations and help one another. The government could establish open platforms such as online websites where user innovators with similar interests can interact. Community innovators innovate for other reasons beyond necessity such as enjoyment, altruism, and skill development; thus, online platforms and the collaboration among users will stimulate users to innovate more.

Another approach is to encourage firms to increase their collaborations with user innovators. At present, firms are not greatly aware of user innovations and sometimes in fact prevent users from innovating due to fears of their products being copied or illegally modified. Moreover, firms, particularly small-and medium-size ones, may be interested in an innovation's concept but not know how to deal with user innovators. The government may intervene by educating firms to understand and acknowledge users' potential via workshops or short introductory courses about user innovation. Policymakers may ask for assistance from educational institutions.

Another method to stimulate interactions between firms and user innovators is to invite firms to collaborate with the user communities that the government establishes or supports. This may take the form of collaboration projects. By participating in these

communities, firms can observe users' ideas and more easily find potential user innovators. Figure 6-2 summarizes the suggestions for policymakers in supporting user innovation at a national level.

Figure 6-2: Role of the government in supporting each sector in the innovation system



This paper illustrates the macro view of user innovation from large-scale national surveys and a case study of government support for user innovation. However, there are some significant points that can be extended in the future.

First, a lack of understanding remains regarding the characteristics and motives of non-community user innovators. Previous research finds community innovators' motives for innovation and information sharing. However, solo innovators' motives for information sharing have not yet been explored. This is significant as these findings could lead to the design of a mechanism that encourages user innovators, either solo or

community, to more widely interact and share information.

Second, future research is advised to explore other means of public support for user innovation. This study indicates that the UDI program marks the beginning of government support for the involvement of users in the innovation process, and that Denmark is the fore-runner as a model for other countries, especially other Nordic countries. The OECD also focuses on this movement (OECD, 2008) and encourages policymakers to encourage users to be active in the innovation process (OECD, 2010). Innovation policies related to users will increase in importance. This calls for further studies to analyze patterns of support and evaluate policy measures.

Appendix-A: Questionnaire (in USA)

We are conducting an academic study to learn more about innovative behavior among people.

Please do not be concerned if you think innovative behavior does not apply to you. You may be doing things without knowing they are innovative. Also, one of the aims of the survey is to establish what proportion of people are innovators.

Section A: Please tell us about yourself.

1. Please tell us your gender. (Please check one option only)

1. Male 2. Female

2. Which of the following best describes your age? (Please check one option only)

- | | |
|--------------------------------|---------------------------------|
| 1. Under 18 years old | 2. Between 18 and 24 years old |
| 3. Between 25 and 29 years old | 4. Between 30 and 34 years old |
| 5. Between 35 and 39 years old | 6. Between 40 and 44 years old |
| 7. Between 45 and 49 years old | 8. Between 50 and 54 years old |
| 9. Between 55 and 59 years old | 10. Between 60 and 64 years old |
| 11. 65 years old or older | |

3. Please tell us your marital status. (Please check one option only)

1. Married 2. Unmarried

4. Which of the following jobs best describes your current employment? (Please check one option only)

- | | |
|--|----------------------------|
| 1. Director of company | 2. Employee (white-collar) |
| 3. Employee (non-white-collar) | |
| 4. Self-employed (for example: commercial, industrial) | |
| 5. Self-employed (for example: independent consultant, lawyer) | |

- | | |
|------------------------------|--------------------------------------|
| 6. Part time worker | 7. Housewife |
| 8. Student | 9. Not working (excluded retirement) |
| 10. Retirement (not working) | 11. Other |
5. In What field have you received formal education?
- | | |
|--------------------------|------------------------|
| 1. Technical/engineering | 2. Business/management |
| 3. Arts | 4. Social Science |
| 5. Other | 6. None |
6. Of these, which is your highest educational attainment?
- | | |
|----------------------------------|----------------------------------|
| 1. Ph.D. or higher. | 2. Master's degree or equivalent |
| 3. Bachelor degree or equivalent | 4. College diploma or equivalent |
| 5. High school diploma or lower | 6. Other |
| 7. None | |
7. How many members are there in your family including yourself? (Please check one option only)
- | | | | | |
|--------|----------|----------|---------|------------------|
| 1. One | 2. Two | 3. Three | 4. Four | 5. Five |
| 6. Six | 7. Seven | 8. Eight | 9. Nine | 10. More than 10 |
8. What was your annual total net (after tax) income in US\$ from all sources in 2009?
- Please select one of the following broad categories. (Please check one option only)
- | |
|---|
| 1. Less than US\$ 20,000 |
| 2. From US\$ 20,000 to less than 40,000 |
| 3. From US\$ 40,000 to less than 60,000 |
| 4. From US\$ 60,000 to less than 80,000 |
| 5. From US\$ 80,000 to less than 100,000 |
| 6. From US \$100,000 to less than 120,000 |
| 7. From US\$120,000 to less than 140,000 |
| 8. From US\$140,000 to less than 160,000 |

9. From US \$160,000 to less than 180,000

10. From US\$ 18,000 to less than 200,000

11. US \$ 200,000 or more

9. What was your expenditure per month (monthly allowance) in 2009? Please select one of the following categories. (Please check one option only)

1. Less than \$100

2. From \$100 to less than 200

3. From \$200 to less than 300

4. From \$300 to less than 500

5. From \$500 to less than 700

6. From \$700 to less than 1,000

7. From \$1,000 to less than 1,500

8. From \$1,500 to less than 2,000

9. More than \$2,000

10. What was your household expenditure per month? (Members who live with you)

Please select one of the following categories (Please check one option only)

1. Less than \$1,000

2. From \$1,000 to less than 2,000

3. From \$2,000 to less than 3,000

4. From \$3,000 to less than 4,000

5. From \$4,000 to less than 5,000

6. From \$5,000 to less than 6,000

7. From \$6,000 to less than 7,000

8. From \$7,000 to less than 10,000

9. More than \$10,000

Section B: Incidence of Product Creation

I would like to ask you about the extent to which you innovate in your private life, that is, outside your job if you have one.

1. During the past 3 years, did you create any products from scratch for your own (or family) use such as tools, toys, sporting equipment, cars, household equipment, software program, or any other things?

1. Yes 2. No 3. Don't know

If Yes, please answer the questions (2)-(17), If No or Don't know, please proceed to question (18) (Section C)

2. What type of product did you create? (Which section of a retail store is it likely to be in?) (Example: Furniture, Home electronics, Toy, Kitchen appliances, stationary, software)
3. What was your most recent product creation? What were the characteristics of that product? How did you make it? How did you use it? Please describe the product creation (Open-ended question) (Please write the materials or tools that you used in a specific detail as much as possible.)

(Ex.1: I created a jig to make arrows. The jig holds the arrow in place and turns at the same time, so I can paint according to my own markings. Jigs available on the market do not rotate.)

Ex.2: As I have a spinal problem, I built a nearly diagonal slope for my keyboard. It is very handy for people who cannot look down when they are typing.)

4. Do you think you were the first one to develop this product creation?

1. Yes 2. No 3. Don't know

5. Did the product you created contain a new function that did not have in the existing products? (Please check one option only.)

<Examples> The jig I created rotates although jigs available on the market do not rotate.

1. Yes 2. No 3. Don't know

6. Did the product you created improve an existing function of products already in the market? (Please check one option only.)

<Examples>

*The existing battery run time is 10 hours while mine is 15 hours.

*The print speed of my printer is two times faster.

1. Yes 2. No 3. Don't know

7. For respondents who replied [1] in Question 6. (Please check one option only.)

Compared to the existing product, to what extent did the product you created improve the existing function of the existing products in the market?

1. Less than 5% 2. From 5% but less than 10%
3. From 10% but less than 15% 4. From 15% but less than 20%
5. From 20% but less than 25% 6. From 25% but less than 30%
7. More than 30%

8. Did you create the product as part of your job?

1. Yes 2. No 3. Don't know

9. Was a product with the same functions available on the market, if you had wanted to buy it rather than make it?

1. Yes 2. No 3. Don't know

10. Did you apply intellectual property rights to protect the product creation (e.g. patents, trademarks)?

1. Yes 2. No 3. Don't know

11. Why did you create the product? To what extent do you agree or disagree with the following statement?

	1. Strongly agree	2. Agree	3. Neither agree nor disagree	4. Disagree	5. Strongly disagree
(a) Because I needed it myself.	1	2	3	4	5
(b) Because I enjoyed doing it.	1	2	3	4	5
(c) Because I wanted to learn or develop my skills	1	2	3	4	5
(d) Because I wanted to help someone else via the item created	1	2	3	4	5
(e) Because I wanted to improve my reputation or gain respect.	1	2	3	4	5
(f) Because it was less costly than purchasing the product in the market	1	2	3	4	5
(g) Because the firms or other people could not reach my needs	1	2	3	4	5

12. Did you share the details of this creation with other consumers or firms?

1. Yes 2. No 3. Don't know

13. If answer to question 13 is yes. Why did you share the details of the creation with other people or firms? To what extent do you agree or disagree with the following statement?

	1. Strongly agree	2. Agree	3. Neither agree nor disagree	4. Disagree	5. Strongly disagree
(a) Because I wanted my idea to be accepted (or admired) by other people or firms	1	2	3	4	5
(b) Because I wanted my idea to be developed further by other people (wanted my product to be improved better)	1	2	3	4	5
(c) Because I expected my idea would be accepted by other people or firms and I may receive financial reward	1	2	3	4	5
(d) Because I had benefitted from other people's ideas before	1	2	3	4	5
(e) I did not expect any admiration or benefits (I created without any particular reasons.)	1	2	3	4	5

14. Did other people or organizations pick up, adopt or copy your creation?

1. Yes 2. No 3. Don't know

15. (Only if 14 = yes): Did you get any compensation?

1. Yes 2. No 3. Don't know

16. Do you belong to a hobby club or a community with a special interest in the type of product you created?

1. Yes 2. No 3. Don't know

17. Did you develop the product creation with the help of others?

1. Yes 2. No 3. Don't know

Section C: Incidence of Product Modification by user

18. During the past 3 years, did you modify ANY products you (or your family) use in your daily life, such as tools, toys, sporting equipment, cars, household equipment, software program, or any other things to make them work for you?

(Note: Please restrict yourself to original changes that the manufacturer did not plan for!)

1. Yes 2. No 3. Don't know

19. What type of product did you modify? (Which section of a retail store should it likely to be in?) (Ex. Furniture, Home electronics, Toy, Kitchen appliances, stationary, software)

20. What was your most recent modification you made? What are the characteristics of that modified product? How did you make it? How did you use it? Please describe the product modification. (open-ended question) (Please write the materials or tools that you used in a specific detail as much as possible.)

<Example> I attached a “Kleenex” type tissue box to a wall near my back door with doubled side tape. I did this when my kids had a cold because I wanted them to remember to take tissues when entering and exiting the house.

21. Do you think you were the first one to develop this modification?

1. Yes 2. No 3. Don't know

22. Did the product you modified contain a new function that did not have in the existing products? (Please check one option only.)

<Example>

*I attached a “Kleenex” type tissue box to a wall near my back door with doubled side tape so that my kids who had a cold remember to take tissues when entering and exiting the house. The product I modified contained a “reminder” function.

1. Yes 2. No 3. Don't know

23. Did the product you modified improve an existing function of products already in the market? (Please check one option only.)

<Examples>

*The existing battery run time is 10 hours while mine is twice longer.

*The print speed of my printer is two times faster.

1. Yes 2. No 3. Don't know

24. For respondents who replied [1:Yes] in Question 23. Please check one option only.

Compared to the existing products, to what extent did the product you modified improve the existing function of the products already in the market? (Please check one option only.)

- | | |
|-------------------------------|-------------------------------|
| 1. Less than 5% | 2. From 5% but less than 10% |
| 3. From 10% but less than 15% | 4. From 15% but less than 20% |
| 5. From 20% but less than 25% | 6. From 25% but less than 30% |
| 7. More than 30% | |

25. Did you modify the product as part of your job?

1. Yes 2. No 3. Don't know

26. Was a product with the same functions available on the market, if you had wanted to buy it rather than make it yourself?

1. Yes 2. No 3. Don't know

27. Did you apply intellectual property rights to protect the modification (e.g. patents, trademarks)?

1. Yes 2. No 3. Don't know

28. Why did you modify the product? To what extent do you agree or disagree with the following statement?

	1. Strongly agree	2. Agree	3. Neither agree nor disagree	4. Disagree	5. Strongly disagree
(c) Because I needed it myself.	1	2	3	4	5
(d) Because I enjoyed doing it.	1	2	3	4	5
(c) Because I wanted to learn or develop my skills	1	2	3	4	5
(d) Because I wanted to help someone else via the item created	1	2	3	4	5
(e) Because I wanted to improve my reputation or gain respect.	1	2	3	4	5
(f) Because it was less costly than purchasing the product in the market	1	2	3	4	5
(g) Because the firms or other people could not reach my needs	1	2	3	4	5

29. Did you share the details of this modification with other consumers or firms?

1. Yes 2. No 3. Don't know

30. If answer to question 29 is yes, why did you share the details of the modification with other people or firms? To what extent do you agree or disagree with the following statement?

	1. Strongly agree	2. Agree	3. Neither agree nor disagree	4. Disagree	5. Strongly disagree
(a) Because I wanted my idea to be accepted (or admired) by other people or firms	1	2	3	4	5
(b) Because I wanted my idea to be developed further by other people (wanted my product to be improved better)	1	2	3	4	5
(c) Because I expected my idea would be accepted by other people or firms and I may receive financial reward	1	2	3	4	5
(d) Because I had benefitted from other people's ideas before	1	2	3	4	5
(e) I did not expect any admiration or benefits (I created without any particular reasons.)	1	2	3	4	5

31. Did other people or organizations pick up, adopt or copy your modification?

1. Yes 2. No 3. Don't know

32. (Only if 31 = yes) : Did you get any compensation?

1. Yes 2. No 3. Don't know

33. Do you belong to a hobby club or a community with a special interest in the type of product you modified?

1. Yes 2. No 3. Don't know

34. Did you develop the product modification with the help of others?

1. Yes

2. No

3. Don't know

Section D: All product creation and modification

If either in Question (1) or/and Question (18), YES, Please answer the questions (35)

– (38) Otherwise, you have finished answering the questions.

Now think about all the modifications and /or creations you have made during the past 3 years.

35. How many times did you create or modify products during the past 3 years?

(times)

36. [Only if the answer in Question (35) is more than 1.]

Did you create or modify one type of product, or on many different types?

1. One type

2. Different types

3. Don't know

37. How much time did you spend on all product creation and modification during the past 3 years?

(days)

38. How much money for tools and materials did you spend on all product creation and modification in the past 3 years?

(dollars)

Appendix-B: Consumer Innovation Questionnaire in Japan

消費者のイノベーション活動に関する調査

(全員の方に)

以下では、あなたがどの程度、日常生活で（お仕事をお持ちの場合はお仕事以外で）イノベーション（革新活動）を行っているかをお伺いします。

現在、市場で購入できる製品（既製品）にない新しい機能や特徴を持ったものを作ったり、より高い性能のものをつくったりした経験についてお答えいただきたいと思います。

パートA

(1) 過去3年間で自分が考えた新しいものを作り出した（創造した）ことがありますか？（○印は一つ）

(1) で①に回答された方へ（その他の方は（8）へ）

どのような製品創造をされましたか？具体的にお伺いします。複数ある方はまず一つ目の例を書いた後で質問（7）で他のものについて別に分けてお教えてください。

実際の例1

(2) どの製品分野の製品ですか（小売店舗のどの売り場で売っている商品ですか）

(例) 家具、家電、おもちゃ、料理用品、文房具、ソフトウェアなど
()

- (3) その製品は具体的にどのようなもので、どのようにして作り、どのように使いましたか？（使った材料・原料、使った器具などもできるだけ具体的に教えてください）

（例）折りたたみが簡単で収納の場所をとらない卓球台を安価な段ボールを使って作り、雨の日に家族で家の中で卓球を楽しむのに使った。

- (4) その製品は既製品にない新しい機能や用途を持つものでしたか（○印は一つ）。

① はい ② いいえ ③ わからない

- (5) その製品は既製品の性能を超えるものでしたか（○印は一つ）。

（例）既製品で10時間のバッテリー駆動時間だったものが15時間になった。プリンターの印字速度が2倍になった。

② はい ② いいえ ③ わからない

- (6) (5) で①と答えた方に質問です（○印は一つ）。

その製品の性能は既製品に比べてどの程度、優れたものでしたか。以下からもっとも近いものを一つ選んでください。

- ① 5%未満 ② 5～10%未満 ③ 10～15%未満
④ 15～20%未満 ⑤ 20～25%未満 ⑥ 25～30%未満
⑦ 30%以上

- (7) 上の他にも他の実例があれば上と同じ要領でお教えてください。

(あ) 製品分野 ()

(い) 具体的説明

(う) 新機能・新用途だったか (○印は一つ)

①はい②いいえ③わからない

(え) 性能向上だったか (○印は一つ)

①はい②いいえ③わからない

(お) 既製品に比べてどの程度の性能向上だったか (○印は一つ)

① 5%未満 ② 5～10%未満 ③ 10～15%未満

④ 15～20%未満 ⑤ 20～25%未満 ⑥ 25～30%未満

⑦ 30%以上

(8) 過去3年間で既製品に手を加えて改良したことがありますか？

(○印は一つ) (①はい、以外の方はパートBに)

(例) 既製品のミニカーのおもちゃのタイヤのゴムに手を加えてさらに速く走れるようにした。

(例) 既製品の机の横にティッシュボックスが入る布カバーをつけてデスクワークをしながら手軽にティッシュを使えるようにした。

(例) ソフトウェアプログラムを書き換えてワードで書いた文章を音声表現できるようにした。

③ はい ②いいえ ③わからない

(8) で①はい、に回答された方へ

どのような製品改良をされましたか？具体的にお伺いします。複数ある方はまず一つ目の事例についてお答えいただき、他の実例については問(14)でお教えてください。

(9) どの製品分野の製品ですか（小売店舗のどの売り場で売っている製品ですか）。

(例) 家具、家電、おもちゃ、料理用品、文房具、ソフトウェアなど。

()

(10) 既製品に手を加えてつくったものは具体的にどのようなものでしたか。

そしてそれをどのようにして作り、どのように使いましたか（使った材料・原料、使った器具などもできるだけ具体的に教えてください）。

(例) 自分が使っている机の側面に自宅で使っていたティッシュカバー（布製）を両面テープで張り付けて、そこにティッシュボックスを入れて、風邪気味の時にそれで鼻をかみながら机の上で作業をした。

(11) その製品は新しい用途や機能を持つものでしたか（○印は一つ）。

(例) ピン先の形を変えて壁にさしてもピン跡がほとんど残らないようにした。

(例) 机にティッシュボックスを固定することで手軽にかつすぐにティッシュをつかって鼻をかめるようになった。

① はい ② いいえ ③ わからない

(12) その製品は、既製品のそれまでの性能を超えるものでしたか（○印は一つ）。

(例) 既製品で10時間だったバッテリー駆動時間が2倍になった。

プリンターの印刷時間が2倍になった。

① はい ② いいえ ③ わからない

(13) (12) で①はい、と答えた方に質問です。

改良した製品の性能は既製品に比べてどの程度、優れたものでしたか。以下からもっとも近いものを一つ選んでください (○印は一つ)。

- ① 5%未満 ② 5～10%未満 ③ 10～15%未満
④ 15～20%未満 ⑤ 20～25%未満 ⑥ 25～30%未満
⑦ 30%以上

(14) 上の他にも他の実例があれば上と同じ要領でお教えてください。

(あ) 製品分野 ()

(い) 具体的説明

(う) 新機能・新用途だったか (○印は一つ)

①はい ②いいえ ③わからない

(え) 性能向上だったか (○印は一つ)

①はい ②いいえ ③わからない

(お) 既製品に比べてどの程度の性能向上だったか (○印は一つ)

- ① 5%未満 ② 5～10%未満 ③ 10～15%未満
④ 15～20%未満 ⑤ 20～25%未満 ⑥ 25～30%未満
⑦ 30%以上

パート B

以下は、問1と問8のどちらか、あるいは両方で「①はい」と回答された方への質問です。その他の方は、パートCへお進みください。

もしあなたが過去3年間に、一つ以上、自分で考えた今までにない新しいものを創造したり既製品を改良したことがあるなら、一番最近行った製品創造あるいは改良について、いくつかの質問をさせていただきたいと思います。言いかえれば、一番最近の事例が、製品創造である方は、その事例を教えてください。一番最近の事例が、製品改良である方は、その事例について教えてください。

(15) あなたが知る限り、あなたがその製品創造あるいは製品改良を一番最初に行った人でしたか？ (○印は一つ)

① はい ② いいえ ③ わからない

(16) あなたはその製品創造あるいは製品改良の内容を他の人に見せたり、話したりして伝えましたか？ (○印は一つ)

① はい ② いいえ ③ わからない

(17) あなたがそのように創造もしくは改良した製品を他の人や企業に公開した動機は何ですか (該当するものはすべて選んでください)。

① 自分のアイディアを他の人や企業に認められたい (賞賛されたい) と思ったから

② 自分のアイディアをさらに他の人と発展させたい (もっとよい製品にしたい) と思ったから

- ③ 他の人や企業に自分のアイデアが採用され、金銭的な見返りが得られるかもしれないと思ったから
- ④ 以前、他の人が考えたアイデアによって自分が助けられた（メリットがあった）経験があったから
- ⑤ とくに他人からの賞賛や見返りの期待はない（なんとなく）
- ⑥ その他 （ ）

（１８） あなたが行った製品創造あるいは製品改良をあなたが知る限りで他の誰か、あるいは企業がピックアップしたり、採用したり、模倣・複製することはありましたか？（○印は一つ）

- ① はい ② いいえ ③ わからない

（１９） （１８）で①に○をした方へ

あなたはそのことで金銭的報酬を受け取りましたか？（○印は一つ）

- ① はい ② いいえ ③ わからない

（２０） あなたが製品創造あるいは製品改良を行ったのはどのような理由があったからですか（該当するものをすべて選んでください）。

- ① 創造あるいは改良した製品を必要としていたから
- ② そうした活動を楽しみたかったから
- ③ 自分のスキル（技量）について学んだり、伸ばしたりしたいと思ったから
- ④ 誰か他の人の手助けをしたいと思ったから

- ⑤ そのことで評判になったり、他の人から尊敬されたかったから
- ⑥ 市販のものを買うよりお金がかからなかったから
- ⑦ 自分のニーズを理解してくれる人や企業がいなかったから
- ⑧ その他 ()

(2 1) あなたは、創造あるいは改良した製品に関連する趣味のサークル（クラブ）やその製品に特別に関心を持つコミュニティに入っていますか。

(○印は一つ)

- ① はい ②いいえ ③わからない

(2 2) あなたはその製品の創造や製品改良を他の人（達）に助けてもらって行いましたか？ (○印は一つ)

- ① はい ②いいえ ③わからない

以下の質問については過去3年の間に行なった「すべて」の製品創造と製品改良について思い出して回答してください。

(2 3) 過去3年間で何回の製品創造や改良を行いましたか？ (○印は一つ)

- ① 1回 ②2回 ③3回 ④4回 ⑤5回
- ⑥6回 ⑦7回 ⑧8回 ⑨9回 ⑩10回以上

(2 4) 過去3年間で、もし2回以上、製品の創造あるいは製品の改良をしている場合、同じ（1種類の）製品でそれを行いましたか？ (問20)で

①の方は④に○をつけてください) (○印は一つ)

- ① 1種類 ②2種類以上 ③わからない

④ 1 回しか製品創造あるいは製品改良をしていない

(25) 過去3年間に行なったすべての製品創造と製品改良を行うためにあなたは、どれぐらいの時間を使いましたか？

_____ 日ぐらい（日数で答えてください）

(26) 過去3年間に行なったすべての製品創造と製品改良を行うために使った道具や材料・原料を購入するのにどれぐらいの金額がかかりましたか？

_____ 円ぐらい

パートC

あなた自身についてお答えください。

(27) 性別（○印は一つ） ①男性 ②女性

(28) 年齢（○印は一つ）

① 15～20歳未満 ② 20～25歳未満 ③ 25～30歳未満

④ 30～35歳未満 ⑤ 35～40歳未満 ⑥ 40～45歳未満

⑦ 45～50歳未満 ⑧ 50～55歳未満 ⑨ 55～60歳未満

⑩ 60～65歳未満 ⑪ 65歳以上

(29) 既・未婚（○印は一つ） ①既婚 ②未婚

(30) あなたのご職業（○印は一つ）

①会社役員 ②会社員（管理職） ③会社員（事務系）

④会社員（労務系） ⑤商工サービス自営業

⑥自由業（弁護士など） ⑦パート・アルバイト ⑧専業主婦

⑨学生 ⑩無職（定年を除く） ⑪定年後無職

⑫その他

(31) 最終学歴（○印は一つ）

- | | |
|------------------------------|--------------|
| ①博士号（Ph.D 又は MD（医学博士）） | ②修士号(Master) |
| ③学士号（学部卒） | ④短期大学・高専卒業 |
| ⑤高校卒業 | ⑥専門学校卒業 |
| ⑦中学卒業 | ⑧小学校卒業 |
| ⑨その他（ ） | ⑩わからない |

(32) 最終学歴の専門分野（○印は一つ）

- | | | |
|---|------|----------|
| ① 理学・工学・技術系 | ②医学系 | ③経営・商学部系 |
| ④ 美術・音楽・文学・芸術系 | | |
| ⑤法学・経済学部などの社会科学系（経営・商学部を除く） | | |
| ⑥ その他（ ） ⑦どれもない ⑧わからない | | |

(33) 同居しているご家族の人数をお知らせ下さい(あなたを含めての人数)

(○印は一つ)。

- | | | | | |
|-------|-------|-------|-------|-----------|
| ① 1 人 | ② 2 人 | ③ 3 人 | ④ 4 人 | ⑤ 5 人 |
| ⑥ 6 人 | ⑦ 7 人 | ⑧ 8 人 | ⑨ 9 人 | ⑩ 1 0 人以上 |

(34) あなたお一人の月間支出をお知らせ下さい（小づかいの額）（○印は一つ）

- | | | |
|------------------|------------------|--------------|
| ① 1 万円未満 | ② 1 ～ 2 万円未満 | ③ 2 ～ 3 万円未満 |
| ④ 3 ～ 5 万円未満 | ⑤ 5 ～ 7 万円未満 | |
| ⑥ 7 ～ 1 0 万円未満 | ⑦ 1 0 ～ 1 5 万円未満 | |
| ⑧ 1 5 ～ 2 0 万円未満 | ⑨ 2 0 万円以上 | |

(35) 世帯の月間支出をお知らせ下さい(同居されている世帯をお考えください)。

(○印は一つ)。

- | | |
|------------|------------------|
| ① 1 0 万円未満 | ② 1 0 ～ 2 0 万円未満 |
|------------|------------------|

③ 20～30万円未満 ④ 30～40万円未満

⑤ 40～50万円未満 ⑥ 50～60万円未満

⑦ 60～70万円未満 ⑧ 70～100万円未満 ⑨ 100万円以上

アンケートへのご協力ありがとうございました。

Appendix-C: Interview questions

1. Questions for the interviews during June 2009 and August 2009

- **Polymakers**

- 1) Please tell the background and the implementation of user-driven innovation program
- 2) Why Denmark became the first country that implemented UDI policy in the world?
- 3) Will you continue this program in the future?
- 4) Please tell the difficulties or barriers that you have encountered.

- **Project participants**

- 1) Have you ever used UDI methods before?
- 2) Please tell about your project (e.g., summary, methodology).
- 3) How did you know about the program?
- 4) What kind of difficulties you have encountered?

- **Academicians/Professionals in the UDI or innovation policy field**

- 1) Comparing to existing innovation policy, what are the similar points and different points of this program?
- 2) Do you agree with the Danish policymakers' action?
- 3) What would be the best way in supporting user-driven innovation?

2. Questions for the interviews during July 5 to July 9, 2010

- **Polymakers**

- 1) Did you evaluate the effect of the program? If so, what are the criteria?
- 2) Please give a few examples of the projects that you think are interesting.
- 3) What were the challenges or difficulties?

4) What will the government do from now on?

- **Program participants**

1) Please tell about the outcome from this project.

2) Please tell the difficulties or barriers that you have encountered.

3) Will you continue implementing UDI projects?

3. Questions for the interviews during March 17-26, 2014

- **Policymakers**

2) Are there any UDI alike programs at present?

3) What are the national strategic policies from now on?

- **Program participants**

1) Please tell about the outcome from this project.

2) Please tell the difficulties or barriers that you have encountered.

3) Will you continue implementing UDI projects?

Appendix-D: List of all the projects in the UDI program

The tables below consist of the project name, methodology or approach, the result, and the outcome categories of the projects in the UDI program. I collected the data from public websites, online reports¹⁹, and personal interviews. Only 60 out of 74 projects have accessible online data.

After collecting the data of each project, I conducted content analysis in order to analyze the project outcome. Eight types of outcome can be observed as follows²⁰:

1. Strengthening knowledge about UDI among participants

Project participants gained better understandings about user-driven innovation methods or process.

2. Better understanding of users (insights)

Project participants gained customer insights or understand their customers better.

3. Product idea/concept development

Project participants could develop new ideas or concepts based on the findings in the project.

4. Product/service development

Project participants could develop new products or service based on the findings in the project.

¹⁹ Documents in Danish were translated by Gramtrans Danish-English translation software.

²⁰ The outcome of each project is probably more various. However, I counted the outcome that was explicitly stated in the document or interviews.

5. User-driven innovation method development

Project participants, especially research institutions and educational institutions, could develop new user-driven innovation methods or improve the existing ones.

6. Knowledge dissemination (e.g., seminar, exhibition)

Project participants disseminated their findings or knowledge to the public such as hosting the seminars, workshops, and exhibitions.

7. Academic research

Project participants published academic papers based on the project findings.

8. Network establishment

Project participants knew new partners and continued their work together in the future.

Table D-1 to Table D-9 summarize all the methods and results of each project and were divided by product categories²¹. Various types of outcome can be observed from all the projects.

²¹ The product categories of all the projects were labeled by the Danish Business Authority.

Table D-1: UDI projects in the climate area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Green city tourism – udvikling af brugerdrevne metoder og innovation af grønne produkter, services og oplevelser i turismebranchen (<i>Green-city tourism - development of user-driven methods and innovation of green products, services and experiences in the tourism trade</i>)	* Map process * Interview with central players * Interview with end users, including hotel staffs and producers	*Customer insight about green tourism * Development of new user-involving methods of ethnological fieldwork around tourists		✓			✓			
Energirigtig minerydning (<i>Energy-correct mine clearing</i>)	The project aims to develop a prototype of a generator that runs on sun, water, wind or hydrogen. This generator must eventually be able to replace and provide an alternative to traditional diesel generators	* Development time and cost reduction * Prototypes				✓				

Table D-2: UDI projects in the construction area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Minimum Configuration - Home Automation (MC-HA)	Observation through 2 chosen families: 1. Ordinary families 2. Energy-Correct families	* Prototype * User insight		✓	✓					
Brugerdreven Innovation, Indlejret teknologi og Byggeri (<i>User-driven Innovation, Embedded Technology and Construction</i>)	* Socio-anthropological interactive methods * Investigation * The use of digital collaborative environment	* Conference * Report						✓		
InnoDoors: brugerdreven innovation i byggebranchen (<i>InnoDoors: User-driven innovation in the building business</i>)	* Interview * Conceptual co-creation * Observation	* Book about the method experience in UDI * New method for measuring companies' readiness to engage in UDI * Project partners get clear insight	✓	✓	✓			✓	✓	

Table D-3: UDI projects in the digital area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Brugerinvolvering i byggeprocessen (<i>Building the procedure of user-involving</i>)	Information and Communication Technology (ICT) supported methodology VIC-MET	A tool or method that is developed in close collaboration between practicing engineers (companies) and university		✓			✓		✓	
LYS - en antropologisk undersøgelse af, hvordan mennesker anvender lys og intelligent lysteknologi i deres hverdag (<i>An anthropological investigation of how human beings use lights and intelligent light technology in their weekday</i>)	A mix method to study people's lighting practices and intelligent home control systems	Customer Insight Information		✓						
Intelligent Utility - Udvikling af platform for brugerdreven serviceinnovation på energiområdet (<i>Intelligent Utility</i>)	Lead user and toolkit method	Toolkit to understand customers (LU method)					✓			

Table D-4: UDI projects in the elderly and disable related area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
i-SIT - Brugerdreven innovation og metoder til udvikling af velfungerende sidde/hvilemøbler med brugeren i centrum velfungerende sidde/hvilemøbler for alle <i>(i-SIT: User-driven innovation and methods for the development of solidly sit/rest furniture for everybody)</i>	The humanistic and social science approach such as anthropology, ergonomics, activity analysis, design, Design for All, and occupational therapy.	* i-SIT resting chair * Network among furniture companies	✓		✓					✓

Table D-5: UDI projects in the experience area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Fremtidens Idræts- og Legelandskaber <i>(House of Monday Morning: Future sports and game)</i>	* Participatory approach * Ethnographic approach	* New insights * Report: “: 'Insights into play - guide to future games landscapes'” * Conference	✓	✓	✓			✓		

Table D-6: UDI projects in the public health area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
maXi-projektet: Nedbrydning af grænser for mestring af kroniske helbredstrusler med IT (<i>Maxi Project: Breaking down of limits to master chronic health threat with IT</i>)	* Workshops * Home visits * Interviews	* Handbook * Board game for educational tutorial * Digital tool	✓	✓	✓			✓		

Table D-7: UDI projects in the regional area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Sund Innovation i Randers Sundhedscenter <i>(Healthcare Innovation in Randers Health Center)</i>	Both private companies and the public sector cooperate in developing ideas for products and services related to diabetes by conducting a series of tests of different user-driven innovation (UDI) methods.	* Solutions that may increase the users experience of security, autonomy and a better life. * New radical ideas leading to development of new types of products.	✓		✓	✓				
Brugerdreven innovation. Vejen til succes med elbiler i Danmark <i>(User-driven innovation. The road to success with electric cars in Denmark)</i>	* Interaction-driven design to develop the infrastructure and the services * Anthropological study * Survey	* Technical information about the test-drivers' driving habits, routines related to charging the car, driving style etc. * Commercially viable business concepts and service solutions for the electric car sector	-	✓	✓					
Brugerdreven innovation i praksis – Formidling af viden		* Dissemination of information on innovation methods		✓					✓	

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
om brugerdreven innovation til vidensservicevirksomheder i Region Midtjylland <i>(User-driven innovation in practice - the Knowledge presentation of knowledge about user-driven innovation to vidensservicevirksomheds in Region Central Jutland)</i>		* Participants gain better knowledge about UDI method can support their business and Implement								
Brugerdreven innovation til udviklingen af velfærdsteknologier <i>(User-driven innovation for the development of welfare technologies)</i>	* Workshop course * User involvement methods	* The region's business community can draw on the experience and methods of user-driven innovation. * Need identification		✓					✓	
Demens i hjemmet <i>(Dementia in the home)</i>		* Workshops and conferences for 200 welfare technology companies in the region * Technology development		✓			✓			

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
		* The companies involved have acquired a new, systematic and scientific knowledge on methods to identify users and customers.								
Forbedret livskvalitet for borgere med kronisk venøse bensår <i>(Improved quality of life for citizens with chronically venous leg wounds)</i>	* Ethnographic studies * User workshops * Lead-user workshops	* Make people more self-reliance * Increase users' quality of life and improve the healing process of chronic venous leg ulcers					✓			
Energirigtig Retrofitting af Laboratorier <i>(Energizing Retrofitting of Laboratories)</i>	* Workshops * Short ethnographic field studies	* Insight into user behavior with regard to energy savings * Energy solution development * Energy-saving retrofitting prototype development and test		✓	✓	✓				
Healthcare Innovation Lab		* Regional collaboration * The establishment of a healthcare and innovation cluster of international caliber						✓	✓	✓

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
		* Development of methodology (e.g. user observation) * Presentation (250 guests)								

Table D-8: UDI projects in the welfare area

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
En kommunal innovationsmodel med brugeren i centrum <i>(A municipal innovation model with the user in the centre)</i>		* UDI Method training * Presentation * New Proposal * Idea and concept development * User need identification	✓					✓		
Brugervenlige og kompetent- egnede emballageløsninger til ældre <i>(User-friendly and competent, appropriate packaging solutions for elderly)</i>		* *Action plan, improvement in traditional meal service * Training * Enhance the quality of life for the elderly * Report on user needs * Menu catalogs/form * New brands and communication concepts for ingredient descriptions * Prototype	✓	✓		✓				

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
		* Better understanding of insight								
Selvhjulpen med teknologi <i>(Self-reliant with technology)</i>	* Anthropology analysis * Workshop and interview(Service design methods)	* Knowledge dissemination * Booklet and website (13 articles) * Catalog about the project's research and concept development phase * New model exhibition * Workshop for companies				✓			✓	
Service og kvalitet i offentlig - privat samarbejde <i>(Service and quality in public-private cooperation)</i>	*Prototype Toolbox *Case collection	* New work method * Better public services * New business area development (private sector)					✓	✓		
Rehabilitering på borgernes præmisser <i>(Rehabilitation on the citizens' terms)</i>		* Development of new services that a rehabilitation process * Development of training method "Step by Step" for patients with chronic pain in joints and muscles * A handbook with recommendations and					✓		✓	

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
		guidelines for public and user-driven rehabilitation.								
SeniorInteraktion – velfærdsteknologi og social interaction (<i>Senior Interaction- welfare technologist waist and social interaction</i>)		* Application which supports that can visualize users’ shopping * Prototype of the user interface * Seminar, website, handbook					✓		✓	

Table D-9: UDI projects in the other areas

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
180° academy (Developing practice-based education in innovation)	-	Academic Institution						✓		
The Pilot Year: Teaching, Exploring and Promoting User Driven Innovation in Industry	Intense 12 months educational program in Interaction Design and Service Design to explore, teach and promote methods of user driven innovation to and with students, teachers, industry and public institutions	Knowledge Dissemination (Courses, Workshop, exhibition)						✓		
People Involvement and Innovations Platform (PIIPL)	Platform development and test	Web application			✓					
Udvikling af metoder i Brugerdreven Innovation for		* Network among furniture companies	✓	✓	✓					✓

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
små og mellemstore virksomheder inden for livsstil, UBIL <i>(Breeding center for-furniture and Wood (UMT): Development of methods in Brugerdreven Innovation for SMEs within life style, UBIL)</i>		* New ideas about furniture								
New Product Development with Lead Users	Lead user method	Better understanding customer needs, Academic theory/method		✓			✓			
Brugerdreven innovation og strategisk design <i>(User-driven innovation and strategic design)</i>		Customer insight, new product ideas		✓	✓					
User-driven innovation in the gaming industry: A lead user model for high tech entrepreneurial start-ups.		Product lines of educational 4 games	✓							

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Undervisning i- og udforskning af metoder til brugerdreven innovation <i>(Teaching and exploration of methods for user driven innovation)</i>		Skill and knowhow about UDI, exhibition	✓					✓		
Brugerdreven innovation af digitale læremidler <i>(User-driven innovation of digital teaching tools)</i>	* Knowledge clarification and investigation designs * Anthropological investigation * Idea- and method development * Prototype	* Four new prototypes * Conference (17 presentations, 260 participants) * Articles			✓			✓	✓	

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Kvindelig betjeningsdesign for avancerede elektroniske produkter <i>(Female service design for advanced electronic products)</i>	* Sex and brain research * Anthropology * Sociology * Psychology * Computer science * User involvement	* New products, that are female driven * New marketing approach * Publication and communication about Female Interaction guidelines * User driven development methods	-			✓	✓	✓		
LIVE (Live Innovation Venue)	* Observation * Workshop	* Prototyped Application smartphone * Experience-based development model * Analytical framework * New way of customer interaction * Know-how to understand users' experience * Mobile application * Conference (More than 100 attendants)	✓	✓	✓	✓		✓		

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Baderum for alle – livslang selvhjulpenhed <i>(Bathroom for everybody - lifelong self-reliantness)</i>		* Workshop with nearly 70 manufacturers, suppliers of bathroom solutions, municipalities, private developers, architects and designers participated * Bathroom products for people with disabilities * Finding publication (pamphlet)			✓			✓		
Bornholmske fødevarer – Fremtidens innovative eksporterhverv <i>(Bornholmian foods - Future innovative export jobs)</i>	*Mapping phase *Observations *Interview	* New ways to develop and market company products * Formation of future cluster project		✓	✓					✓
Co-Creation Design Network, Copenhagen	Co-creation method	* Knowhow about co-creation * Network * Seminar (200 participants)							✓	✓
Den gode cykeloplevelse <i>(The good bicycle experience)</i>	* Ethnographic * Observation * Semi-structured interviews	* Customer Insight * Business model * Conference			✓	✓			✓	

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
Fremtidens supermarked <i>(Future Supermarket)</i>	* Mapping with focus group * Lead User interview * Observation by food sociologist	* Business strategic proposal * Store concept business models for future value-oriented food * Reinforcing elements of the value chain (investment in knowledge) * Strategic and tactical initiatives across supermarket value chain			✓	✓				✓
Innovativ brugerdreven forretningsudvikling <i>(Innovative user-driven business development)</i>		* Service concept development * Improving the efficiency of production processes * Sales improvement * Company started to aware of customer value		✓		✓				
Use Box – brugerredskaber og metoder til skabende innovation <i>(Use Box - User tools and methods for creative innovation)</i>	Toolkit method	* Toolbox for firms to prepare and innovate with users * Conference * Webpage that provides tutorial						✓	✓	
Events og mobile medier	Anthropological methods	* Application to events					✓	✓		

Title in Danish (English Translation)	Method/Approach	Result	Knowledge about UDI among participants	Better Understanding of users	Product Idea/Concept	Product/Service	UDI Method Develop	Knowledge Dissemination	Academic Research	Network
<i>(Event's and mobile media)</i>		* Improvement of company business strategy * New anthropological methods * Seminar and Conference * Tourism improvement								
Det borgernære hospital <i>(The citizen-close hospital)</i>		* A generic model of the patient's journey in health care * Knowledge collection about users-driven innovation methods * Identification of opportunities and barriers for the Danish telemedicine industry		✓	✓					
JOIN: Joint Online Innovation Network	Online community	Co-creation platform for lifestyle products					✓			

Reference

1. Allen, R. C. 1983. "Collective invention." *Journal of Economic Behavior & Organization* 4, no. 1: 1-24.
2. Antorini, Y.M., A.M. Muniz, T. Askildsen. 2012. "Collaborating with Customer Communities: Lessons From the Lego Group" *MIT Sloan Management Review* 53, no.3: 73-79.
3. Arrow, K. 1962. "Economic Welfare and the Allocation of Resources for Invention From The Role and Direction of Inventive Activity." In R.R. Nelson, ed., *The Rate and Direction of Inventive Activity*. Princeton University Press.
4. Baldwin, C. Y., C. Hienerth, E. von Hippel. 2006. "How user innovations become commercial products: A theoretical investigation and case study", *Research Policy* 35: 1291-1313.
5. Bogers, M., A. Afuah, and B. Bastian. 2010. "Users as innovators: a review, critique, and future research directions", *Journal of management* 36: 857-875.
6. Bureau of Economic Analysis. 2009. *Benchmark Input-Output (I-O)*. U.S. Department of Commerce. Available from: <http://www.bea.gov/industry/>
7. Chaminade, C., C. Edquist. 2005. From Theory to Practice: the Use of Systems of Innovation Approach in Innovation Policy. CIRCLE Electronic Working Paper, no. 2005/02.
8. DAMVAD. 2009. *Midtvejsevaluering af program for brugerdreven innovation*. DAMVAD.
9. Danish Enterprise and Construction Authority. 2007. *Executive Order on project grants under the programme for user-driven innovation*. Ministry of Economic and Business Affairs.
10. de Jong, J. and E. von Hippel. 2008. User Innovation in SMEs: Incidence and Transfer to Producers. Working paper, EIM: Zoetermeer, The Netherlands.

11. de Jong, J. and E. von Hippel. 2009. Measuring user innovation in Dutch high tech SMEs: Frequency, nature and transfer to producers. Working paper, MIT Sloan School of Management.
12. Eisenberg, I. 2011. "Lead-user research for breakthrough innovation." *Research-Technology Management* 54, no.1: 50-58.
13. Flowers, S, T. Sinozic and P Patel. 2009. Prevalence of User Innovation in the EU- Analysis based on the Innobarometer Surveys of 2007 and 2009. Innometrics. Proinno Europe.
14. Flowers, S, E von Hippel, J. de Jong and T Sinozic. 2010. Measuring user innovation in the UK-The importance of product creation by users. NESTA.
15. FORA. 2005. Innovation Monitor 2005: Denmark's innovation Capacity-From benchmark to policy priorities. FORA, Ministry of Economic and Business Affairs.
16. Franke, N., and S. Shah. 2003. "How Communities Support Innovative Activities: An Exploration of Assistance and Sharing Among End-Users. ", *Research Policy* 32, no. 1: 157–178.
17. Franke, N. and E. von Hippel. 2003. "Satisfying heterogeneous user needs via innovation toolkits: the case of Apache security software." *Research Policy* 32, no.7: 1199-1215.
18. Franke, N., E. von Hippel, M. Schreier (2006). "Finding commercially attractive user innovations: A test of lead user theory." *Journal of Product Innovation Management* 23, no.4: 301-315.
19. Freeman, R. B. 1995. "The large welfare state as a system." *The American Economic Review* 85: 16-21.
20. Füller, J., Jawecki, G., and H. Mühlbacher. 2007. "Innovation creation by online basketball communities" *Journal of Business Research* 60, No.1: 60-71.
21. Gault, F. and E. von Hippel. 2009. "The prevalence of user innovation and free

innovation transfers: Implications for Statistical Indicators and Innovation Policy.”

MIT Sloan Research Paper No. 4722-09.

22. Godin, B. 2006. “The Linear model of innovation the historical construction of an analytical framework.” *Science, Technology & Human Values* 31, no.6: 639-667.
23. Gustafsson, R., E. Autio. 2011. “A Failure Trichotomy in Knowledge Exploration and Exploitation.” *Research Policy* 40, no.6: 819-831.
24. Hauknes, J. 1999. Economic Rationales of Government Involvement in Innovation and the Supply of Innovation-related Services. STEP Report.
25. Herstatt, C. and E. von Hippel. 1992. “Developing New Product Concepts Via the Lead User Method: A Case Study in a “Low Tech” Field.” *Journal of Product Innovation Management* 9, no.3: 213-221.
26. Henkel, J and E. von Hippel. 2005. “Welfare Implications of User Innovation.” *Journal of Technology Transfer* 30, no.1/2: 73-87.
27. Herstatt, C. and E. von Hippel. 1992. “From Experience: Developing New Product Concepts via the Lead User Method.” *Journal of Product Innovation Management* 9, no.3: 213-222.
28. Hertel, G., Niedner, S., and S. Herrmann. 2003. “Motivation of software developers in Open Source projects: an Internet-based survey of contributors to the Linux kernel.” *Research policy* 32, no.7: 1159-1177.
29. Hienerth, C., E. von Hippel, A. Jensen, and M. Berg. 2012. Efficiency of consumer (household sector) vs. producer innovation. Working paper, MIT Sloan School of Management. 4926–11.
30. Hienerth, C., and C. Lettl. 2011. “Exploring how peer communities enable lead user innovations to become standard equipment in the industry: Community pull effects.” *Journal of Product Innovation Management* 28, no.1: 175-195.
31. Høgenhaven, C. 2005. *Brugerdreven Innovation i dansk mode – en*

surveyundersøgelser. FORA, Ministry of Economic and Business Affairs.

32. Jensen, T. E. 2012. "Intervention by Invitation: New Concerns and New Versions of the User in STS." *Science Studies* 25, no.1: 13-36.
33. Jeppesen, L. B., and M. J. Molin. 2003. "Consumers as Co-developers: Learning and Innovation Outside the Firm" *Technology Analysis and Strategic Management* 15, no. 3: 363–384.
34. Jeppesen, L. B., and L. Frederiksen. 2006. "Why do users contribute to firm-hosted user communities? The case of computer-controlled music instruments." *Organization Science* 17, no.1: 45–63.
35. Jeppesen, L. B., and K. Laursen. 2009. "The role of lead users in knowledge sharing." *Research Policy* 38, no.10: 1582-1589.
36. Karau, S. J., and K.D. Williams. 1993. "Social loafing: A meta-analytic review and theoretical integration." *Journal of personality and social psychology* 65, no.4: 681-706.
37. Kim Kim, Y., and H Kim. 2010. User innovation in Korean manufacturing firms: Incidence and Protection. Working paper, KAIST Business School.
38. Kotler, P. and G. Armstrong. 2012. *Marketing: an Introduction*. 12th edition, Pearson.
39. Kuusisto, J., J. de Jong, F. Gault, C. Raasch, and E. von Hippel. 2013. Consumer Innovation in Finland-Incidence, Diffusion, and Policy implications. Proceeding of the University of VAASA reports no. 189.
40. Lakhani, K. R., and R. G. Wolf. 2003. Why hackers do what they do: Understanding motivation effort in free/open source software projects. MIT Sloan Working Paper 4425–03.
41. Lakhani, K. R., and E. von Hippel. 2003. "How open source software works: "free" user-to-user assistance." *Research policy* 32, no.6: 923-943.

42. Lettl, C., C. Herstatt, and H. G. Gemuenden. 2006. "Users' contributions to radical innovation: evidence from four cases in the field of medical equipment technology." *R&D Management* 36, no.3: 251-272.
43. Lerner, J., and J. Tirole. 2002. "Some simple economics of open source." *The journal of industrial economics* 50, no.2: 197-234.
44. Lilien, G. L., P. D. Morrison, K. Searls, M. Sonnack, and E. von Hippel. 2002. "Performance Assessment of the Lead User Idea-Generation Process for New Product Development." *Management Science* 48, no. 8: 1042–1059.
45. Lundvall, Bengt Åke. 1992. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter Publishers.
46. Lundvall, Bengt Åke. 2002. *Growth, Innovation and Social Cohesion: The Danish model*. Elgar Publisher.
47. Lüthje, C., C. Herstatt, and E. von Hippel. 2002. The Dominant Role of Local Information in User Innovation: The Case of Mountain Biking. Working Paper, MIT Sloan School of Management.
48. Luthje, C. 2004. "Characteristics of innovating users in a consumer goods field: An empirical study of sport-related product consumers." *Technovation* 24, no.9: 683–695.
49. Lüthje, C., and C. Herstatt. 2004. "The Lead User Method: An Outline of Empirical Findings and Issues for Future Research." *R&D Management* 34, no. 5: 553-568.
50. Metcalfe, J. Stanley. 1994. "Evolutionary Economics and Technology Policy." *the Economic Journal* 104, 931-943.
51. Ministry of Internal Affairs and Communications. 2007. *Survey of Research and Development*. Ministry of Internal Affairs and Communications. Available from: <http://www.stat.go.jp/english/data/kagaku/1530.htm>
52. Morrison, P., J.H. Roberts, E. von Hippel. 2000."Determinants of User Innovation

- and Innovation Sharing in a Local Market." *Management Science* 46, no.12: 1513-1527.
53. Myers, S., and D.G. Marquis. 1969. *Successful industrial innovations: A study of factors underlying innovation in selected firms*. Washington, DC: National Science Foundation.
 54. National Science Foundation. 2008. *Business R&D and Innovation survey*. National Science Foundation. Available from:
<http://www.nsf.gov/statistics/srvyindustry/about/brdis/>
 55. Nelson, R.E. 1993. *National Innovation Systems—A Comparative Analysis*. Oxford University Press.
 56. Nelson, R. R., and S. G. Winter. 1982. *An evolutionary theory of economic change*. Harvard University Press.
 57. Nishikawa, H., M. Schreier, and S. Ogawa. 2013. "User-generated versus designer-generated products: A performance assessment at Muji." *International Journal of Research in Marketing* 30, no.2: 160-167.
 58. Nyholm, J. and L. Langkilde. 2003. *Et benchmark studie af innovation og innovationspolitik – hvad kan Danmark Lære?*. FORA, Ministry of Economic and Business Affairs.
 59. OECD. 2008. *OECD Science, Technology and Industry Outlook*. OECD Directorate for Science, Technology and Industry.
 60. OECD. 2010. *The OECD Innovation Strategy: Getting a head start on tomorrow*. Organization for Economic Cooperation and Development.
 61. Ogawa, S. 1998. "Does Sticky Information Affect the Locus of Innovation? Evidence from the Japanese Convenience-Store Industry." *Research Policy* 26, no.7-8: 777-790.
 62. Ogawa, S., and F. Piller. 2006. "Reducing the risks of new product development."

MIT Sloan Management Review 47, no.2: 65–72.

63. Ogawa, S., and K. Pongtanalert. 2011. Visualizing the invisible innovation continent: Evidence from global consumer innovation surveys. SSRN Working Paper, doi: 10.2139/ssrn.1876186.
64. Oliveira, P., and E. von Hippel. 2009. “Users as service innovators: The case of banking services.” *Research Policy* 40, no.6: 806–818.
65. Raasch, C., C. Herstatt, P. Lock. 2008. “The dynamics of user innovation: Drivers and impediments of innovation activities.” *International Journal of Innovation Management* 12, no.3: 377-398.
66. Raymond, E. 1999. *The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*. O’Reilly Media.
67. Redmond, William, H. 1995. “An Ecological perspective on New Product Failure: The Effects of Competitive Overcrowding.” *Journal of Product Innovation Management* 12, no.3: 200-213.
68. Poolton, J., and I. Barclay. 1998. “New Product Development from Past Research to Future Applications.” *Industrial Marketing Management* 27: 197-212.
69. Regeringen. 2005. *Nye mål*. VK Regeringen.
70. Rosted, J. 2003. *Tre former for innovation*. FORA, Ministry of Economic and Business Affairs.
71. Rothwell, R., C. Freeman, A. Horsley, V. T. P. Jervis, A. B. Roberts, and J. Townsend. 1974. “SAPPHO Updated: Project SAPPHO Phase II.” *Research Policy* 3, no.3: 258-291.
72. Schaan, S. and M. Uhrbach. 2009. Measuring User Innovation in Canadian Manufacturing. Statistics Canada. Available from: <http://www.statcan.gc.ca/pub/88f0006x/88f0006x2009003-eng.htm>. [26 December 2014].

73. Schreier, M. and R. Prugl. 2008. "Extending Lead-User Theory: Antecedents and Consequences of Consumers' Lead Userness." *Journal of Product Innovation Management* 25, no.4: 331-346.
74. Shah, S. 2000. Sources and Patterns of Innovation in a Consumer Products Field. Working paper, MIT Sloan School of Management.
75. Shah, S. K., and Tripsas, M. 2007. "The accidental entrepreneur: The emergent and collective process of user entrepreneurship." *Strategic Entrepreneurship Journal* 1, no.1-2: 123-140.
76. Skiba, Florian. 2007. "Lead Users as Source for Radical Service Innovations." In Kersten, et al. (Eds.), *Innovative logistics management: competitive advantages through new processes and services*, 213-230.
77. Statistics Bureau. 2005. *2005 Input-Output Tables for Japan*. Ministry of Internal Affairs and Communications. Available from: <http://www.stat.go.jp/english/data/io/>
78. Urban G and E von Hippel. 1988. "Lead User Analysis for the Development of New Industrial Products." *Management Science* 34, no.5: 569-582.
79. Utterback, J. M. 1974. "Innovation in Industry and the Diffusion of Technology." *Science* 183, no. 4125: 620-626.
80. von Hippel, E. 1976. "The dominant role of users in the scientific instrument innovation process." *Research Policy* 5, no.3: 212-239.
81. von Hippel, E. 1988. *Source of Innovation*. Oxford University.
82. von Hippel, E. 1994. "'Sticky Information' and the Locus of Problem Solving: Implications for Innovation." *Management Science* 40, no.4: 429-439.
83. von Hippel, E. , and G.V. Krogh. 2003. "Open source software and the "private-collective" innovation model: Issues for organization science." *Organization science* 14, no.2: 209-223.
84. von Hippel, E. 2005. *Democratizing Innovation*. MIT Press.

85. von Hippel, E. 2007. "The HBR List-breakthrough ideas for 2007." *Harvard Business Review*, February 2007, 27-28.
86. von Hippel, E. and P. Oliveira. 2009. Users as Service Innovators: The Case of Banking Services. Working Paper, MIT Sloan School of Management.
87. von Hippel, E. and J.P.J. de Jong. 2010. Open, distributed and user-centered: Towards a paradigm shift in innovation policy, Scientific Analysis of Entrepreneurship and SMEs. EIM Research Reports H 201009.
88. von Hippel, E., S. Ogawa, J. P.J. de Jong. 2011. "The Age of Consumer-Innovator" *Sloan Management Review* 53, no.1: 27-35.
89. von Hippel, E., and H. DeMonaco. 2014. Market failure in the Diffusion of User Innovations: The Case of "off-label" Innovations by Medical Clinicians. SSRN Working paper. Available from: SSRN 2275562.
90. Wasko, M. M., and S. Faraj. 2000. "'It is what one does': Why people participate and help others in electronic communities of practice." *Journal of Strategic Information System* 9, no.2: 155–173.
91. Woolthuis, R. K., M. Lankhuizen, and V. Gilsing. 2005. "A System Failure Framework for Innovation Policy Design." *Technovation* 25, no.6: 609-619.