

# A Comparative Study of Online User Communities Involvement In Product Innovation and Development<sup>\*</sup>

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**Abstract:** Customer's involvement in product development process, especially in idea generation, product conceptualization and the prototyping, has been examined in several literatures. It is well-known that "online user communities" have provided a firm to leverage the creativity of its customers in all stages of the product development process. Nevertheless, the literature lacks a conceptual understanding on how different types of online user communities can influence the product innovation and development. In this study, "online user communities" are classified, by their characteristic of community members and interaction level, into five types: virtual customer community, beta testing volunteer corps, user content collaboration innovation community, user development community and user product collaboration innovation community. Within these online user communities, we find that (1) different online user communities can be used at different stage of product development. It is more noteworthy that "user product collaboration innovation community" can be used at all stages of the product development process, especially in design & engineer phase that less explored in literatures. (2) firms play a supporting /complementary role within "user collaboration innovation community" in contrast to the rest online user communities.(3) there is a significant difference between the five type communities in knowledge creation, sharing and diffusion.(4) there are some implications of "user product collaboration innovation community" which pushes the firms to justify their organizational governing mechanism, in contrast to the rest online user communities. Finally, we conclude that all these ways of investigation would naturally lead into very interesting issues of innovation management and organizational innovation.

**Keywords:** Innovation Management, Product development, Organization Innovation, virtual community, User Community, Collaboration.

## Introduction

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Recently, some scholars have noted the importance of user's participation in innovation and the development model trend of "user communities'" participation in product development in organizations. Under the current business environment, manufacturers can no longer produce and manage knowledge alone. They need to create knowledge jointly with their customers. As "User Collaboration Innovation Communities" provide business organizations with surprising, innovative capabilities, the innovative management model, which is based on the user communities, would require the manufacturers to re-inspect their organizational innovative governing structure. Therefore, this research attempts to understand this phenomenon by re-classifying the current online user communities from the perspective of product innovation and development. There is an extreme need for the study of user communities with the hope that the re-classification will be helpful for the continuing research.

The structure of this article is as follows. The first part states briefly the background and the motivation of this research. The second part is document review and evaluation. The third part tries to reclassify the current online user communities from the perspective of product innovation and development and has resulted in five different models of user communities. The fourth part is the comparison and discussion of the five models. Lastly, we will further discuss the deficiencies of the User Collaboration Innovation Communities, theoretically and practically, to suggest the feasibility of the research direction in the future.

## **Literature review**

This section examines, first, the importance of customers in the innovation of an organization's knowledge with references to relevant documents on the changes of customers' roles and the meaning of their roles to the innovation of business value. After that, this research examines related research performed by scholars in the past on the roles that customers play and on the manner in which the customers participate in new product development and also reflects the insufficiency of the current research on the manner and the development of user communities' participation in new product development.

### **The Change of Customers' Roles**

Ancestor researchers pointed out that the concept of the value chain will be replaced by the value innovation system of the value constellation and the value

network and also emphasized that customers may be involved in the value innovation system to create a dependent relationship better than the past relationships (Norman & Ramirez, 1993; Ramirez, 1999; Prahalad & Ramaswamy, 2000, 2002; Lee, 1999, 2001; Kambil et al., 1999; Friesen, 2000; Sawhney & Prandelli, 2000). For example, Value Constellation proposed by Norman & Ramirez (1993), Value Co-production proposed by Ramirez (1999), the Third Generation (half) of Knowledge Management proposed by Lee, Jen-Fang (1999, 2001), Co-creation of Prahalad & Ramaswamy, (2002); Kambil, et al., (1999); Friesen, (2001); and Sawhney & Prandelli, (2000), Customer as Innovator proposed by Thomke & von Hippel (2002), and the Customer Capital Theory proposed by Stewart (1997). All these theories also mention the more and more vague borderlines of manufacturers' organization and the overlapping borderlines between suppliers and customers. In addition, production and consumption activities have obvious overlapping in the areas of business definition, organization operation and value creation, which are all different from before. These points of views were echoed by Pavitt (2002); Brusoni et al. (2001); Richardson (1972); Leonard-Barton (1995); Nonaka & Toyama (2002); and Venkatraman & Henderson (1998). They pointed out that effectively absorbing external technical knowledge is important to businesses. The customer is one of the sources from which important technical knowledge can be obtained. Real operation proves that the importance of customers is emphasized in different management territories. von Hippel (1998, 2002); Lee, Jen-Fang (1999, 2001); Prahalad & Ramaswamy (2000, 2002) further proposed that users have been proved to be developers of important innovation in many territories and are major sources of innovation that you should not be neglected. In addition, the territory of innovation has slowly moved towards users according to the progress of time. von Hippel (2002) proved that users, but not manufacturers, are typical initial developers in many product territories. Also, innovation developed by users has later lead to important new products and processes in businesses. Knight (1963); Enos (1962); Freeman (1968); Lionetta (1977); Shah (2000); von Hippel (1976, 1977); VanderWerf (1982) proved that users innovation is not a rare thing. Literature on strategy, organization, and product innovation research all emphasize the importance of customers in the innovation of organization knowledge. This research plans to further investigate how customers create value jointly with organizations and how organizations should adjust their corresponding organization platform and management ideas.

### **The role the customers play in the knowledge creation**

Prahalad & Ramaswamy (2000) felt that due to the emerging of networks,

businesses can no longer play the same role they played in the past. Consumers have begun to aggressively generate conversations with manufacturers. These conversations are no longer controlled only one-way by businesses. Each independent consumer may discuss with other consumers, respond, and learn business related knowledge, and consumers may even initiate conversations. The market has become a world where public criticism is common. Consumers are gradually stepping out of their traditional role and turning simultaneously into both creators of values and consumers, and becoming competitors of manufacturers in creating values. Based on this situation, Prahalad & Ramaswamy (2000) proposed three stages in the evolution of customers' roles and noted several key points in different stages.

In documents regarding strategic management and quality management, researchers classify customers, in the process of creating values, into two large categories and five different roles. According to Finch (1999), Gersuny & Rosengren (1973), Kaulio (1998), Lengmich-Hall (1996), the first category is: Customers assume the role of the upper stream as an input party. They become part of the organization's activities including customer as resource, and customer as co-creator/co-producer. The second category is: Customers assume the role of the lower stream as an output party including customer as buyer, customer as user, and customer as product. Nambisan (2000, 2002) felt that the above classification structure might be used to examine customers' participation role in new product development, especially in the three customers' roles of resource, co-producer, and user. This research paper employs this structure to review results of related research on customers' role in knowledge creation.

### Customer as Resource

Customer's involvement in product development process, especially in idea generation, product conceptualization and the prototyping, has been examined in several literatures (Christensen, 1997; von Hippel, 1988; Leonard-Barton, 1995; Winsted, 1990; Rothwell et al., 1974). From the summary of the conclusion of documents on the customer as resource, companies must select different customers, based on the difference of the characteristics of the product technology and the market, and establish effective and appropriate interactive relationships with them, so as to use customers as the basis for sources of creating new products for the company (Christensen, 1997; Leonard-Barton, 1995; Lynn et al., 1996). In addition, companies also have to generate appropriate encouragement policies to enhance customers' intention of contributing ideas on new products. Finally, how to obtain customers'

knowledge in an effective and economic manner has always been a challenge faced by businesses. Thomke & von Hippel (2002) felt that the difficulties of product development were that the information for demand comes from customers, while the information on resolution relies on manufacturers. Manufacturers must collect related information on customers' demand through various channels. However, this process is tremendously costly and is time consuming. Because customers' demands are normally very complicated, obscure, hard to understand and change swiftly, traditional market research technology can only glance the surface and can not express related information clearly or completely.

#### Customer as Co-creator/Co-producer

Customers also assume the role of co-creator of new products, from product design to product creation, including assurance of the selection of the product structure, design of the product characteristics and the product sequence, the specifications demanded by the product interface, and the establishment of the creation process. Compared with consumer products (Luthje, 2000; Shah, 2000; Franke & Shah, 2002; Luthje et al., 2002), customers' involvement in the joint innovation of industrial products is more obvious (Garvin, 1988; von Hippel, 1988; Herstatt & von Hippel, 1992; Riggs & von Hippel, 1994; Morrison et al., 2000). Thomke & von Hippel (2002) felt that so far the method of turning customers into innovators appears mainly in B2B areas. However, numerous signs reflect that, in fact, similar methods are also very popular in B2C areas. Regardless of whether they are consumer products or industrial products, manufacturers normally benefit from customers' joint innovation in the area of product design. Schneider & Bowen (1995) defined five incentives to encourage customers to be co-creators/co-producers. In addition, some scholars pointed out that the "the relative expectations of innovation-related benefits" and the "the allocation of innovation-related sticky information" will affect whether or not users are willing to participate in innovation and will impact the strength of the innovation activity. The two reasons will also facilitate in predicting both whether user innovation will appear and the frequency of its appearance in product areas (Shah, 2000; Ogawa, 1997; Riggs & von Hippel, 1994). Thomke & von Hippel (2002) pointed out that the method for "customers as innovators" is for suppliers to provide customers with tools. These are tools which are easy for users to operate. (von Hippel, 2001; Thomke, 2001) called them "toolkits for customer innovation". Most of them adopt new technologies, such as computer simulation and fast prototyping, which allow customers to perform product design and development. For example, in terms of software, they allow users to attach the

module designed by customers to products with standard specifications. Thomke & von Hippel (2002) felt that this action switches the interface positions of “supplier-customer”. The repetitive trial and error processes which are unavoidable in product development are all carried out by customers. The result is a tremendous enhancement of speed and effectiveness.

From the summary of the conclusion of documents on the customer as co-creator/co-producer, we can tell that if companies hope to utilize users’ own knowledge to be fully responsible for product design and development, companies must be willing to assume the role of teacher and educate their customers as though they were training their employees. Users also must be willing to invest a sufficient amount of time and resources to be able to become related technology experts. From this point, we know that both producers and customers must make more effort than before. Therefore, how to educate and encourage customers to be willing to participate in co-creation is the challenge the company must face. Kambil et al. (1999) pointed out that it is not easy to utilize customers’ knowledge. At least, in order to overcome the difference in the goals of both parties, both parties must consider what they want to obtain from the cooperative relationship and what is the corresponding return they want to get. Sawhney & Prandelli (2000) further pointed out that if the reason why the co-creation of knowledge cannot proceed is the customers’ lack of learning capability, lack of trust of businesses, and lack of motivation to create knowledge, the resolution will be to invest in developing a language for both parties to communicate or to increase technological connectivity between businesses and consumers. For example, through the dialogue on the construction virtual space or (von Hippel, 2001 and Thomke, 2001) talked about the toolkits for consumer innovation that. Both may reduce the required time and effort that customers have to spend on obtaining business knowledge and sharing knowledge, further help customers to understand the implemented knowledge, increase customers’ willingness to share knowledge with businesses, and improve the quality of customers’ knowledge. In addition, investing in business brand and image to establish customers’ trust will be beneficial to customers’ sharing and the joint creation of knowledge. Last, businesses must find a method to repay customers, and the encouragement method may be economic or non-economic. Just as Thomke & von Hippel (2002) mentioned, because turning customers into innovators may bring uncertainties to the development of projects, a new supervising and control management mechanism is needed to assure quality and efficiency of development and to effectively integrate customers and the internal development team.

## Customer as User

As users, customers may create valuable output in product testing and product support.

It is not new that customers assume the role of testing new products. Early research also proved that customers assume the roles that have an extremely high level of productivity in the product and original module testing (Dolan & Mathews, 1993; Nielsen, 1993). In both industrial and consumer goods, we can see customers' participation in product testing. It is even more obvious in the software industry (Cusumano & Yoffie, 1998; MacCormack et al., 2001).

As users, customers may provide product support to other users. Customers often obtain professional knowledge related to products from continuous accumulation of usage experience and then further provide assistance to other users. Also, these professional users often are more capable of resolving product problems than manufacturers' internal product assistance professionals (Kay, 1999). With the aid of the internet in recent years, manufacturers are able to support customers' interaction with tools that are low cost effective and develop multiple interaction relationships among customers, relationships beyond the double directional interactive relationship between manufacturers and customers. Nambisan (2000) mentioned that in order to encourage mutual assistance between customers, manufacturers might authorize a certain customer a special position in the community, which will make him more willing to contribute to product support.

Summarizing the discussion of documents on the customer as user, we can conclude that companies can, through the low cost basic structure of networks, distribute their trial testing products to consumers with various backgrounds and can assist customers form self help communities to provide product support.

## **Theory on Customers' Participation in New Product Development**

Maidique & Ziger (1985) felt that a successful product development process occurred when the business often and deeply interacted with customers during the product development and announcement processes. (Souder et al., 1998; Sherman et al., 2000) also had similar findings and conclusions. They felt that the research and development staff should interact directly with customers and build relationships with customers during the new product development stage. It would help new product

development tremendously. Gupta & Souder (1998) also proposed that customers' early participation has been proved to be an important contributory factor for the success of new products. From the perspective of product R&D, Kaulio (1998) performed a complete review on the methods of customers' participation in new product innovation. Kaulio (1998) proposed that the types of activities that customers participate in product development include design for customers, design with customers, and design by customers. The phases that customers participate in product development include specifications establishment, concept development, detail design, prototyping, and final product. Kaulio (1998) found that the development phases that customers mainly participate in are specifications establishment, concept development, and the prototyping. Customers participate less in detail design and final product. Leonard-Barton (1995) proposed the "modes of User Involvement" in which users participate in companies' new product development, and summarized users' participation into four modes. This concept is similar to the concept proposed by Kaulio (1998). She found that when users aggressively participate in the complete process of product development, the average time spent is shorter. Campbell & Cooper (1999) felt that this was because the first interaction with customers could effectively gather market information, could also provide the ability and other resources that the company lacks internally, and could further shorten development time and reduce costs. However, Leonard-Barton (1995) found that there was no definite relationship between the level of users' participation and the success of a project. (Bidault & Cummings, 1994; Burce et al., 1995; Schrader & Gopfert, 1998; Dolan & Matthews, 1993) also had the same point of view. They found that the cooperation between customers and companies do not automatically guarantee success because of the following problems: the fact that customers have limited experience and ability, that customers have limited professional knowledge, customers' involvement in time and degree, customers' willingness to provide accurate knowledge, early exposure of product testing, and the creation of uncertain or unrepresentative feedback. Wayland & Cole (1997) felt that even though numerous documents supported the claims and the operations management proclaimed exaggeratedly the importance of customers' participation in product development, most customers play a passive role in most industries. The reason was that the communication and the cost needed to include customers in product development are too high. However, following the continuous emergence of communication and information technology, the link between customers and products has been greatly enhanced, and the possibility to include customers as product innovation partners is dramatically increased. Dahan & Hauser (2002) felt that communication and information technology could rapidly and economically incorporate customers in

product development systems, especially enhancing both parties' abilities in communication, conceptualization, and implementation.

Summarizing review on the methods of customers' participation in new product development, we know that it is not a new concept to learn from customers and to listen to customers. From the re-inspection of products based on customers' complaints, which occurred commonly in the past, to the emphasis on customers' participation in establishing product concepts, which exists currently, the realization of "marketing-orientation" is not just production-orientation by pushing products to customers, it is marketing through numerous interactions and obtaining knowledge from customers. However, because it normally is a costly and deficient process to fully understand customers' needs, besides trying to grasp customers' needs, companies have also started to provide customers with tools which allow them to design and develop products by themselves. Summarizing the classification of the types of customers' participation proposed by Leonard-Barton (1995) and Kaulio (1998), we find that the Consultancy Mode proposed by Leonard-Barton corresponds to the strategy of design for customers proposed by Kaulio. The Codevelopment Mode corresponds to the strategy of design with customers. The Apprenticeship Mode corresponds to the strategy of design by customers. In addition, from the level of customers' participation in each phase of product development, we can tell that the incorporation of customers is done mostly by utilizing various marketing techniques, to discover customers' needs, regardless of whether the needs are well known/expressive or whether the level of needs is inexpressive. This condition is even more obvious in the design for customers and design with customers. In fact, customers rarely participate in the stage of the development of engineering technology. Even in the design by customer, which involves engineering development, (1) most of the time, customers are allowed to select among limited numbers of standard models and combinations. Customers have almost no room to utilize their creativity and to really innovate. It is just a concept of mass-customized production. It is still not common to allow customers to become innovators by providing them with sufficient freedom to create and to design innovative, customer created products that may truly satisfy their needs. (2) Even if customers are really allowed to become the companies' internal innovation partner, because of all kinds of limitations, normally only a small group of customers may participate and the participating customers have to pass through the filtering process performed by the company. Therefore, the number of participating customers cannot be expanded. (3) Customers participate only in a certain specific period of time during product development, and the participation is work-orientation. Therefore, customers and companies normally keep a structured

relationship, a temporary relationship that will be dissolved just after the completion of the work. There are also very few interactions between customers.

Before the Internet, businesses could still interact with their customers. However, only a few employees could interact with customers at the same time. In addition, businesses could also handle communications with individual customers and provide products. Nevertheless, it could be performed only on a limited basis. Luckily, the Internet changed everything. It allows businesses to create a high level of interactions and individualizations with customers within a range that has no boundary. However, even though Dahan & Hauser (2002) mentioned that the Internet enhances the depth and the breadth of customers' participation, businesses use the Internet only to look into customers' potential demands through the basic tool of the web page, but do not really allow customers to be involved in the process of creating product value. This situation does not correspond to the concept of "may utilize online customer communities to open new product development model", which was proposed by Kambil et al., 1999; Friesen, 2001; Sawhney & Prandelli, 2000; and Nambisan, 2001, 2002.

### **Theory of User Communities' Participation in New Product Development**

Figallo (1998) explained that the definition of virtual community would be different based on different researchers' points of view. Therefore, the definition of virtual community normally reflects the researchers' subjective ideas. Komito (1998) also pointed out that the reason for the deficiency and the differences in the definitions of virtual community is the reflected diversification in its development. The situation of arguments about virtual communities existing in most studies, and the lack of common acknowledgement of virtual communities may reflect different interpretations and positions that each researcher has on the concept of community. For example, some studies emphasize the importance of community in the aspect of knowledge or technology innovation. However, there exist different terms and meanings based on the differences of the observed organizations.

From the research overview and the contents of discussions on virtual communities, we know that most studies focus on the similarities and differences of actual communities and virtual communities. Some research focuses on empirical studies including media characteristics, format, participants' attitude and behaviors, and satisfaction level. Some research employs transaction activities as the core for studying virtual communities, mostly focusing on the real business operation of

improving marketing, or even regarding managing virtual communities as an important, profit making model for businesses. Lately, scholars even study communities from the perspective of knowledge sharing or technology innovation. However, the level of the analysis is between the country and the manufacturers, but does not include the users. What is called a virtual community in this study means a community oriented by the collaboration innovation between users. The key point of the discussion is how these users perform network collaboration innovation through networks, but not from the basic point of transactions and marketing. Instead, it focuses on technology innovation. Therefore, “virtual community oriented by transactions” proposed by Armstrong & Hegel (1997) is not included in the conceptual model of the innovative activity of the customer community investigated in this study. In addition, the way Armstrong & Hegel (1997) classified a virtual community into four large categories, based on the interactions, does not conform to the requirement of this study that investigates community-based innovation systems by user networks. Lastly, the concept of “user collaboration innovation community” studied by this research is different from the virtual community mentioned in many documents such as the communities of practice by Brown & Duguid (1991), the on-line communities by Rheingold (1994), and the virtual communities by Armstrong & Hegel (1997). It is also different from the virtual organization proposed by Chubin & Hackett (1990); Davidov & Malone (1992); Castells (1996); and Hedbear et al. (1997). Virtual organizations focus mainly on the networks and the alliances between companies and companies, but not the networks and alliances between individuals.

Even though the study of user based virtual communities accumulates and provides many valuable opinions, it is limited to the discussion of virtual communities in relation to types of transactions, relationships, and interests, and mostly is limited to the application of marketing. This research focuses less on the virtual community which follows the “product development orientation”. Therefore, this research attempts to reclassify the current online user community from the perspective of “product innovation development”, so as to facilitate continued research.

### **Classification of Online User Communities’ Participation in New Product Development**

This study is based on the four dimensions of online users’ participation in new product development: “characteristics of community participants”, “user interaction level”, “interactions between community participants and manufacturers”, and “new

product development phase” and classifies online users into five different categories including “virtual customer community”, “beta testing volunteer corps”, “user content collaboration innovation community”, “user development community”, and “user product collaboration innovation community”. The result of the classification and its details are as follows:

Table 1 Classification of Models of User Communities’ Participation in New Product Innovation

Community Characteristics		Virtual Customer Community	Beta Testing Volunteer Corps	User Content Collaboration Innovation Community	User Development Community	User Product Collaboration Innovation Community
<b>Characteristics of Community Participants</b>		General Users	Early Adopters	General Users	Innovators Early Adopters	Innovators Early Adopters
<b>User Interaction Level</b>	Information/Knowledge	Consumption Information/Technology Information	Consumption Information	Content Information	Technology Information	Technology Information Technology Knowledge
	Link	✓	✗	✓	✓	✓
	Innovation	✗	✗	✓	✓	✓
	Collaboration	✗	✗	✓	✗ Independent Creation	✓
<b>Interaction between community Participants</b>	Long Time	✗	✗	✓	✓	✓
	Guidance	✓ Manufacturers	✓ Manufacturers	✓ Manufacturers	✓ Manufacturers	✗ User Community
	Participation Model	Consultancy Mode (Dialogue)	Consultancy Mode (Dialogue)	Apprenticeship Mode (Creation)	Apprenticeship Mode (Access)	Apprenticeship Mode (Experiment)
<b>Phases Involved in Product Development</b>		Launch	Testing	All stages	All stages	All stages
Cases		Amazon.com	B-site test before Microsoft was sold in the market	Open Directory /Slashdot.org	PalmPilot/ GE Plastic web site	Linux/Mozilla/ Sun’s OSS projects

**Characteristics of Community Participants.** Adopting the classification employed by Rogers (1995) and Moore (1995) on the characteristics of customer innovation. Rogers (1995) classified the adopters in the technology adoption life cycle as innovators, early adopters, early majority, late majority, and laggards. This classification is similar to the five categories classified by Moore (1995): technology enthusiasts, visionaries, pragmatists, conservatives, and skeptics. Even though the

terms for the classifications are different, the meaning is exactly the same.

***User Interaction Level.*** There are four dimensions of the structure, formal ties, information/knowledge shared by members of the community, percentage of innovation in community activities, and collaboration.

*Formal ties.* Evaluated based on whether there is a formal, regular community club on the web to connect people in the community in long-term relationships.

*Types of knowledge shared by people in the community.* This study revises the knowledge classification index proposed by Lee Jen-Fang, Lai Chen-Nang, Lai Wei-Lung(1998) and classifies knowledge into four categories. They are technology knowledge, technology information, consumption information, and content information. Technology knowledge is knowledge in a technical area. It requires people who have in-depth knowledge of technology to be able to absorb the information effectively. All technologies required for the actual design, research and development, and product manufacturing process are called technology knowledge, such as the original code of a software. Technology information is also knowledge in a technical area. The difference is that it is technology knowledge with which the general public may come into contact. The difficult technology knowledge is packed or concealed, such as software that has been compiled. Consumption information is knowledge in the area of information including customers' demands and preferences. Content information is also knowledge in the information area, but include information other than marketing.

*Percentage of innovation in community activities.* Uses whether there is creation of new products and the strength of the percentage of innovative activities in the community activities as criteria for judgment.

*Collaboration.* Uses whether there is collaboration between communities in the process of creating innovative products as criteria for evaluation.

***Interaction between community participants and manufacturers.*** Measurement of the strength of this interaction is based on the index of “long period of joint work with community participants”, the “strength of manufacturers' guidance”, the “participation model”, and “whether the organization structure is formal”.

*Long period of joint work with community participants .* Uses the time the community participants spend on working with manufacturers in the whole product development stage as the measurement criteria.

*Strength of manufacturers' guidance.* Because each model of a user community web site has two large categories, including user voluntarily formed user web sites and business web sites. This phase employs business web site (user communities initiated

by manufacturers) as discussion subjects. The strength of the guidance is measured by the authority to determine the operation direction of the community.

*Participation model.* Classification is based on the four modes of user involvement proposed by Leonard-Barton (1995) including delivery mode, consultancy mode, codevelopment mode, and apprenticeship mode. Among these, this study further classifies the apprenticeship mode into three large categories: creation, experiment, and access. In the apprenticeship mode, the community participants assume the role of developers to be fully responsible for product development. The difference in these three categories is that “access” means there is no collaboration process between developers, but developers have free access to the technology they need through technology packaging and concealment. However, “experiment” means a collective creation model between developers. Developers experiment with products, exchange experiment ideas, and assist to develop products through networks. Collaboration is also a “creation” model. The difference between “creation” and “experiment” is that “creation” is creation of content information, but not product development.

*Whether the organization structure is formal.* Whether the organization of the user community is structured or not is used as the evaluation standard. Especially whether the organization is integrated with the development process of the manufacturers’ original product.

*Involved product development stage.* Based on whether their different areas of study are industries or objects, each scholar has different interpretations of the stages of new product development. However, they all have a common point of view. That is, new product development is initiated at the existence of innovation, through the operation of new product projects in the organization, and at the introduction of new products in the market. Therefore, this plan divides the stages of new product development as: opportunity assurance, idea generation, concept development and testing, technology engineering and design, prototyping and testing by employing customers as objects, and introduction to the market.

User communities’ participation and product development in an organization can be summarized into five different models:

### **Model 1 Virtual customer community**

This community is a virtual community composed mainly of customers who had experience in using products. Key participants in the community cannot clearly classify it into any category under Rogers’ (1995) classification. Therefore, community participants in this model are all called general users. Most users in this

community possess the same interests and experiences. They get together to chat online or exchange personal experiences and side news through bulletin boards, and comment on products and services. The development of this type of community came mostly from voluntary gatherings of users. However, in recent years, manufacturers have realized the tremendous value and benefits that the discussion contents, personal attitudes and behavior of members of the virtual communities bring to marketing. Therefore, many business web sites have started to aggressively operate this type of virtual communities to obtain benefits from them (Armstrong & Hegel, 1997). The creation content of this community is accumulated gradually. Its value is that it is a group experience and develops points of view generated from verification and comparison. It is different from the creation content that has themes and organizational structure. This type of creation content is helpful in the areas of the spread of reputation, products and service support, users' hidden behaviors, and the understanding of demands. Therefore, managing this type of community is beneficial for performing service support and marketing activities (such as market evaluation studies and promotion activities) during the product development stage. This stage is defined in this plan as the marketing stage. The participation model of this community belongs to the consultancy model. Manufacturers increase mutual understanding and knowledge sharing through dialogue. The time spent on interaction between the community participants and the manufacturers is not long. The community organization is mostly non-structured, and mostly does not affect the operation of the original organization structure. In addition, the formation of this type of community is mostly initiated by manufacturers, and its operation, such as the limitation on members' qualification, the encouragement policies, and the operation rules, is guided by manufacturers. Amazon.com community, operated by a business company, and the MVP (Most Valuable Professional) program run by Microsoft are all cases under this model.

### **Model 2 Beta Testing Volunteer Corps**

It is common in the software industry to employ early adopters as subjects to perform prototyping and testing. Early adopters like to investigate the breaking through ability that new technology brings, and their participation motivation is to know the most advanced technology. In the early days, there was no specific community web site for community participants to communicate with each other. The communication was mostly through the customer service centers or the web page provided by the company, and the participants reflect trial condition, in one direction, to the company. The contact between communities was nothing but sporadic discussion occurring in the discussion section on the web. The participants seldom formed regular

communities. They normally interacted directly with manufacturers, and there were no innovative activities between the members in the communities, not to mention creation of the collaboration interaction model. In addition, community members only interacted intensively with companies during new product testing period. There are not many interactions at other times, and the testing activity and the follow-up analysis are mostly performed and organized by companies. However, in recent years, companies have also utilized the distribution of trial versions or testing software to enhance their reputations and to increase market shares. They have also started to establish designated web sites to provide to web users for downloading and communicating and interacting with other users. Compared with other communities, the connection level between members in the community is not very strong.

### **Model 3 User Content Collaboration Innovation Communities**

The user content collaboration innovation community is a model of a volunteer community of collective creation and compilation through networks. Because the content material of the creation does not involve difficult technology knowledge, whoever is interested may join the creation line. There are no obvious differences between users. The establishment of the community web site may be voluntary, such as the collaboration of “steam bun and noodles” which is famous in the Taiwan networks, or it may be initiated by business organizations, such as the open directory by Netscape and the Slashdot.org by Yahoo, which is a web site for news. In addition, we may find that user content collaboration innovation communities initiated by business organizations all have strict quality control and filtering processes.

### **Model 4 User Development Communities**

User development communities are formed mainly by innovators and early adopters. These communities perform mainly product innovation activities such as development and design. Innovative products are mostly for personal use or to be distributed for other people to use, in limited forms such as fee collection or trial usage. Each innovative product is completed independently by developers and no collaboration is required during the innovation process. There are designated web sites where the communities gather, and members of the communities spread distribution products and exchange usage feelings through the web site. Communities will also exchange ideas about the technical problems that they encounter during the creation process. However, the exchange is mostly on technology information, but not on technology knowledge at the level of intellectual property. Some user development communities are formed voluntarily by communities and some are established by companies. Business companies' intention is to cultivate the development of communities through

constructing community web sites, holding technology seminars, providing development tools, and providing encouragement rewards. As for business companies, the operating user development community may allow users to develop the products they need, as in the case of the GE plastic web site (Thomke & von Hippel, 2002), or they may allow the development of supplementary products that are appropriate for the company, further strengthening the company system structure to increase the external value of the users' network, such as the software development community operated by PalmPilot.

### **Model 5 User Product Collaboration Innovation Communities.**

User product collaboration innovation communities are formed mainly by innovators and early adopters. These communities consist mainly of a group of technology enthusiasts in the hacker level who are responsible for product development. The characteristics of these communities are, employing separate groups, connecting separate resources through the Internet, transmitting fragment knowledge through knowledge sharing and constructive criticism, and simultaneously testing and designing products. These communities exhibit fast development, new added functions, and revision of pre-existing errors. Communities may obtain profits from the creativity and the cooperative behavior of a group of numerous developers because they may gather the collective wisdom of thousands and millions of network elite, may simultaneously study multiple resolutions of a problem, and may finally select the best case, through parallel processing by colleagues. It not only saves costs, but also enhances efficiency. Because users are innovation contributors, they understand their own needs and they respond hastily and provide their contribution. Besides exchanging technology problems encountered in the creation process, communities also exchange technology knowledge involved at the level of intellectual property. In addition, intellectual property is not controlled by one single entity. There are voluntarily formed user product collaboration innovation communities. The most famous one is the operation model in the Linux community, which is the model example of the operation of a community. User product collaboration innovation communities may also be formed by business companies. The most famous one is the release of the source code of Communicator 5.0 by Netscape. After that, Sun, IBM, HP, and RealWork all had the plan to release source code, the result of R&D. The reason why these companies aggressively fought for the release of original codes was to obtain the input from the research and development of original code communities. They hoped to build another successful legend like Linux with the strength of the open source software community. Regardless of whether the communities are formed voluntarily or for business, their control mechanism is more

open. Even business companies cannot completely guide them because whether the user product collaboration innovation communities that are originated by business organizations may exist smoothly totally relies on the continuous innovation of the community. Therefore, most organizations operate these communities through close connection and interaction and follow the operation norms of the communities. The following will use the OpenOffice project performed by Sun to explain the operation of these communities.

Sun bought StarDivision Company in 1999 and obtained the copyright of StarOffice 5.2, the major product of StarDivision. In October, 2000, Sun announced most of the source code of StarOffice, allowed the public to download the source code or to compile OpenOffice through the Internet, and formed OpenOffice.org to be responsible for the maintenance of OpenOffice. Because OpenOffice included nine million lines of source code, this release became the largest release of open source software project in history. There were more than twenty sub-plans under OOo (OpenOffice.org) with a total of more than one hundred modules. So far there are more than fourteen thousand users registered in different discussion groups. In the last two to three years, OpenOffice has gradually published new editions. StarOffice, published by Sun, was the superb source code extracted from OpenOffice.org plus source code developed by Sun internally. From edition 5.2 to edition 6.1 in 2003, there have been many improvements. The results are abundant.

The software development model of OOo and the operation model of the company's internal software project are different. The complete software development direction of OOo does not have the traditional development process of "planning, composing, testing". Instead, it adopts the flow of "bug-driven development" and "distributed development". The development of software can follow only the large direction and abstract documents, there are no detailed planning design documents. Through the process of testing or inspecting source code, users report errors or provide suggestions and patches in each discussion group and e-mail discussion. Or they can rewrite the program directly and add what they like or delete what they dislike. Their ideas regarding needs and design are spread in discussion groups and mail discussion. Testing and deleting errors are performed simultaneously and this information can be forwarded to other users who are also interested in this issue. The management team does not have to make a priority list, to make a TODO list, or to list items that have the highest production priority. It is an ad-hoc requirement process and a continuous design adjustment.

There are many employees from Sun in the OOO development community. Of course, there are also many amateur developers. Sun adopted users' responses as a reference for the improvement of new versions of OpenOffice. Users not only may provide usage feelings, opinions, ideas about new functions, bug report, but also may correct program errors through personal examination of the source code, and provide feedback. Therefore, users may actually participate in the development process of OpenOffice. The direction of the future development of OpenOffice is mostly determined by the opinion of the members of the community. Only one of the nine members in the core organization of the community is selected from among Sun employees, all others are selected from leaders of sub-project plans of the community or from outstanding contributors. Community management only plays the role of integrating and communicating everybody opinions. It does not interfere with the direction of the product development, which is determined collectively by all members in the community. The management does not interfere with developers' works or opinions, it just works on resolving different opinions to obtain common acknowledgement. For example, they coordinate each developer's opinion in the whole project team to assure the development work of each module and the whole development work is performed as scheduled. The developers, that have more than ten thousand people, are regarded to be a gigantic development team. When someone intends to proceed a sub-project under a certain project, vote will be taken to determine whether the sub-project should be proceeded.

OOO released the source code of the software with dual-license strategy including LGPL (GNU Lesser General Public License) and SISSL (Sun Industry Standards Source License). LGPL is a looser GPL license for non-business usage. Software developers may deliberately revise the source code and may publish or do not announce the revised source code. SISSL is a Sun Industry Standards Source License to be used for business. It allows other manufacturers to revise the source code of OpenOffice and to commercialize the program codes without publishing their own source code. For example, StarOffice published by Sun, SuperOffice Suite published by IBM, and RedOffice published by Red Flag are all commercial software in Office series that are developed based on the related format of the source code of OpenOffice and API. The difference between them and OOO is that these manufacturers charge a fee after they revise or include some additional functions in the original program. Sun employs hybrid business model to allow different customers to obtain benefits. One way is to provide program developers and users with free "open source code production line". New functions and new standards appear first in the format of open source code, further accelerate the innovation of OOO, and assure the quality of the

software. Because these source code will be examined by experts in the global network, it is hoped that the business will obtain innovation effect and occupy market share. On the other hand, through chargeable “business production line”, Sun also provides business users who need the software with reinforced version. The business version of StarOffice maintains sources of profits for the business and provides development resources for the open source code version of OOo. It also satisfies business customers’ special needs.

### **Comparison and Discussion of the Five Online User Communities’ Involvement in New Product Development Models**

The following is the comparison and discussion of the five communities. We will discuss from the following perspectives: types of knowledge users contribute, the roles they assume in the new product development process, the difference in knowledge creation, knowledge added value and diffusion, and how business organizations operate the five communities.

#### **Type of knowledge users in the five communities contribute and the role they assume in the process of new product development.**

In the user communities of model 1 and model 2, the knowledge users contribute is mostly consumption information, and they assume the role of resource and user in the new product development process, as is proposed by Nambisan (2000, 2002). The management of model 1 communities facilitates the operation of service support and marketing activities in the product development stage. It is also the stage of introducing the products to the market. These communities are not directly involved in engineering technology for product development. The management of model 2 communities is helpful for testing new products. Likewise, these communities are not directly involved in engineering technology for product development. These two models of communities assume the role of consultation for manufacturers during the new product development process of business organizations. Manufacturers dialogue with the communities through the operation of the communities and obtain needed information.

In the user communities of model 4 and model 5, the knowledge contributed by users in these communities is production and technology related knowledge. They assume the role of co-creator/producer in the new product development stage, as is proposed by Nambisan (2000, 2002). As to the user communities in model 3, even

though the knowledge contributed by users is just content information and is not involved with difficult technical knowledge, they assume the role of co-creator/producer in the new product development stage, as Nambisan (2000, 2002) proposed. In model 3, 4, and 5, users assume the role of developers. They participate in the complete process of new product development in an organization, and are directly involved with engineering technology and techniques that are required for product development. Therefore, the communities in the last three models have more innovation behaviors than the communities in the first two models. It is not just simple information sharing. In other words, knowledge creation behavior exists in the communities in the last three models, but not the first two models.

### **General comparison of model 3, 4, and 5**

Even though innovation behavior exists in the user communities of model 3, 4, and 5, there still are obvious differences among them. First, communities of model 3 and model 5 complete the innovation process through collaboration. That is, the joint creation model exists between communities. The difference is that model 3 is creation of content information, but model 5 is product development and experiment. However, communities in model 4 create their own work independently in the innovation process. There is no collaboration process between communities. Communities pick up the technology they need freely through technology packaging and concealment. Second, the interaction between communities in model 3 and model 4 is exchange of content information and technical information, but not exchange of technology knowledge in the level of intellectual property right. However, communities in model 5 not only will exchange technical problems encountered during the creation process, but also involved with the exchange of technology knowledge in the intellectual property right level. Thus, we know that the knowledge flow for communities in model 3 and model 4 is not much difference from that of model 1 and model 2. It is mostly information flow. However, the knowledge flow of communities in model 5 is not only information flow, but also flow of technology knowledge. Therefore, there is an obvious knowledge value added behavior of technology transmission, accumulation, and diffusion. This is not easy to be noticed in the previous four models. Because model 5 involves in communities' collaboration and cooperation to jointly develop products, especially communities are also involved in the exchange of technology knowledge in the level of intellectual property right, the operation of these communities will have the property right related issues, will have leadership and control related issues, such as coordination and encouragement, that the operation of other communities will not encounter.

## **Business organizations' management principle and business model towards the five models of communities**

As for business organization, operating the first two models of communities is to utilize customers' consumption knowledge to facilitate marketing and service of the company's products. That is the well-known virtual community management principle. Operating the last three models of communities is to utilize customers' knowledge in the production area. In order to effectively utilize customers' knowledge in the production area, most manufacturers will provide members in the community with education and training, development tools, seminars, and rewards, treat customers like the company's employees, expect customers to develop the products they need or develop supplementary products that are appropriate for the company, hope to stimulate and accelerate the innovation development of products through the interaction with communities, so communities may become the innovation engine of the company. In the management of the first four models of communities, companies normally play an active role to establish a web site and to cultivate communities intentionally. In addition, managing communities in the first four models will not affect the organization structure of the company's projects, the problem of copyright, and the business model. However, as to the management of the communities in model 5, because it involves with sharing and diffusion technology knowledge with customers, and the customers assume a strategic role in the product development process, company normally plays a supporting role in the operation of this type of community. The real key innovation role is the user communities. Company plays a supporting and supplementary role. Management function in the communities is just to communicate and to coordinate, but not to control or to lead. The core management team is shared leadership performed by both the company's employees and the external core developers. The borderline between the company and users is very vague. As for the company, managing this type of communities that are centered with innovation development is not just setting up web sites. The company also has to consider the revision of the structure of property right, the organization platform, the project coordination manner, the adjustment of customers' relationship model, and the new creation and experiment of business models. Maximizing the efficiency of the communities with leverage operation, and creating values that are different from the input value of the products for customers.

## **Conclusion and Suggestion**

Summarize and compare the classified five models, we know that compared with other four models, the user product collaboration innovation communities in model 5 is less familiar to the industry and the academia.

As for the academia, so far there has been little research on the “innovation system based on user communities”. The models proposed by research report were normally descriptive. The research reports were based on several well-known case studies and existed different, contradictory points of view. Take the OSS (Open Source Software) project as an example, most research reports investigated OSS from the technology perspective of software engineering. There has been very little research on the organization study of the development process of OSS. It makes the “user communities based innovation system” become an area that extremely needs to be investigated, either theoretically or practically, under the organization issue of product innovation. As for research area, documents related to organization innovation mostly focused on discussing the innovation behavior and the innovation determination factor adopted by organizations internally. Documents related to organization innovation did not investigate the innovation model consisting of “networks and alliances between individuals” or “organization and user communities”. In fact, what is the difference between this type of innovation model and the traditional model? How should we operate its organization design and its property right system? What factors determine the key points of the success and the failure of organization innovation? Briefly speaking, can the organization platform of user collaboration innovation communities and the currently existing organization models or theories explain or describe it? Therefore, the meaning of the above questions, either in the theoretical aspect or in the practical aspect, definitely needs to be clarified.

As for industries, when the intellectual property is released to the public, the property right is lost. The challenges that the companies are facing are how to reach a balance between the protection of property right and the open strategy, so as to obtain the biggest profits and also adapt to the property right management structure under the innovation development model that is centered with communities. Currently, hybrid property right management structure is still under experiment. We still don't know what kind of mechanism should be employed to replace it. The feasibility and the effect of the operation are also waited to be further investigated and verified. There is also a lack of research on how to utilize “user product collaboration innovation community” to obtain benefits. How should manufacturers utilize customer communities to accelerate customers' participation in each development stage of

product innovation? How should businesses adjust their organization model, business model, customer relationship model, project coordination manner, knowledge sharing manner, so as to maximize the efficiency of the communities with leverage operation and to create values that are different from the input value of the products for customers? How can manufacturers receive business profits, provide feedback, and also manage communities? How to utilize property right system design to encourage communities' participation and innovation? When is the appropriate time for the application of property right system? What is the feasible design of the hybrid property right system in the future? Briefly speaking, how can user collaboration innovation communities be initiated and utilized by businesses and companies? What is the communities' meaning to the innovation organization and strategies? These are all practical issues that require in-depth investigation for the research in the future.

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