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Research on the Motives and Models of Online Community Users' Participation in Enterprise New Product Development

-- Taking Xiaomi community as an example

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Abstract: With the advent of the "Internet +" era, companies gradually realized that users are increasingly participating in corporate activities through online communities. This user-centric innovation model has posed a huge challenge to the traditional enterprise-centric model. Therefore, it is very important to study the motivation of online community users to participate in product innovation. Based on the analysis of the existing research results, this paper divides the influencing factors of users' participation in new product development into three dimensions based on social capital theory, proposes assumptions, and introduces knowledge contribution as an intermediary variable to establish a model. At the same time, grab the user data of the MIUI section of the Xiaomi community for empirical research and verify the proposed hypothesis. Finally, combined with the results of case analysis, strategies and suggestions on how to better motivate customers to participate in the development of new products in enterprises are proposed.

Keywords: Online community; User participation; Social capital; Knowledge contribution; Users participate in product innovation.

1. Introduction

1.1. Research background and significance

1.1.1. Research background

Information retrieval and interactive communication through the Internet has become a part of people's daily life. With the popularity of the Internet, online communities have also developed rapidly. In the increasingly competitive market environment, enterprises are facing many problems, such as the diversification of user needs, the shortening of product update cycle, and the increasing cost of product development. Therefore, if enterprises want to form and maintain their competitive advantage, the development of new products is very important. However, due to the uncertainty and complexity of innovation, it is more and more difficult for enterprises to meet the needs of users only by relying on their own resources for product development. Therefore, the traditional scientific and technological innovation activities centered on scientific researchers have begun to turn to a new mode centered on users. This innovation mode with the background of "Internet +" has stimulated innovation and development in various fields. In the era of "Internet +", enterprises need to establish extensive communication and cooperative development with users to gain competitive advantage. Crawford noted that user engagement is a valuable resource that helps businesses design and innovate products efficiently. Enterprises can obtain more accurate user demand information and innovative ideas from users, so as to reduce the failure rate of product innovation, save innovation costs, and then improve the performance of new product development, which plays a positive role in promoting enterprise innovation.

As an information exchange platform, online community can realize the exchange and interaction of creativity between users, and has become one of the important channels for enterprises to use user innovation resources to develop new products. In this environment, users' participation in enterprise innovation has been gradually valued by enterprises, and they have built user interaction platforms, such as Dell, Starbucks and the HOPE platform of Haier in China, Xiaomi's Xiaomi Community and Huawei's Pollen Club, which are all open innovation platforms created to collect users' ideas and invite users to make suggestions for their new product development online. It can be said that user participation in online communities has become the source of new product development for enterprises.

Although the emergence of online communities provides convenience for users to participate in the development of new products, how to encourage users to actively participate in online communities still needs to take into account the impact of many factors. Previous studies mostly focus on the internal and external rewards of social exchange theory to explore the motivation of user participation in innovation, ignoring the social aspects of social capital. Therefore, based on the social capital theory, this paper analyzes the motivation of users in online communities to participate in new product development.

1.1.2. Research purpose

The purpose of this paper is: firstly, through investigation, analysis and demonstration, to grasp the current situation of online community users' participation in new product development; Then, taking Xiaomi Community, a well-developed online community in China, as the research object, this paper constructs a model according to user participation behavior, and finds out the various motivations that contribute to user participation behavior through empirical research, so as to enrich the existing theory. Finally, it provides ideas for enterprise product innovation from the perspective of user participation.

1.1.3. Research significance

(1) Theoretical significance

Compared with offline participation, online participation of users in new product development has many advantages. However, most of the existing research focuses on offline, and the research on online user participation in new product development is relatively scarce. This paper starts from user participation, taking Xiaomi community as an example, combining quantitative and qualitative analysis, through the first-hand data obtained, to understand the specific situation of user participation motivation, and on this basis, to explore the relationship structure between various motivations and user online participation behavior, which is of certain significance to expand the framework of user participation system and enrich the theory of new product development research in online community.

(2) Practical significance

For users, it is necessary to make them realize that participating in the process of new product development is not only a kind of effort, but also a way to help enterprises provide products that meet their needs. For enterprises, attracting more capable and creative users to participate in the development of new products can not only broaden the innovative thinking of enterprises, improve the innovative ability of enterprises, but also enhance the customer satisfaction of enterprises and form brand effect. Therefore, encouraging users to participate in the development of new products has important guiding significance for the production practice of enterprises.

1.2. Research methods

In order to get scientific and effective research results, this paper uses a combination of qualitative analysis and quantitative analysis to analyze the motivation of users' online participation in new product development.

(1) Literature research method

Through the research on user participation, online community, user participation and product innovation, we can better understand the research progress of researchers in this field. Through the comparative analysis, we find the defects of the existing research, and finally choose the social capital theory as the theoretical basis of this study.

(2) Crawler data collection method

The interviewees in this study are users who participate in the development of new products in the millet community. They use the user information discussed and exchanged in each section of the circle as the data source, and use crawler software such as Octopus collector and Python to capture the data on the web page regularly. Set the information to be captured regularly on the crawler software, capture the relevant data by stages, extract and save it to the Excel document.

(3) Quantitative analysis method

Firstly, the crawled data is preprocessed, and then the statistical analysis is carried out. Statistical analysis and correlation analysis were carried out based on SPSS19.0 and other statistical software.

1.3. Research innovation

(1) Most of the studies on the factors that affect users' participation in online communities are based on social interaction theory. In this paper, we construct a virtual model based on the framework of social capital theory to analyze the motivation of users' participation in product development, and enrich the existing research results on user participation behavior in online communities.

(2) This paper selects Xiaomi Community, a well-developed online community in China, as an example to verify the community, because Xiaomi Community fully integrates user suggestions into the development of mobile phones and operating systems, making its products more in line with user needs, improving user satisfaction, and better encouraging users to participate in new product innovation. Therefore, with the help of empirical analysis, this study has more practical significance.

(3) Different from the existing literature, which uses the questionnaire analysis method based on the subjective data of users, this paper uses the objective data for empirical analysis. Using crawler software such as Octopus collector to capture the actual behavior data of users in the millet community circle as a measure for data analysis, objective data can make the analysis results of this paper credible and authentic.

2. Literature review and related theories

2.1. Review of relevant research

2.1.1. User participation

Table 1. Definition of User Participation

	Scholar	Definition
Create value	Ritter (2003)	Users provide innovative knowledge and other resources for product development or innovation in the process of new product development.
	Guo Chen (2013)	Users invest their time and wisdom to bring service transformation and quality improvement to enterprises.
Relationship	Namsivayam (2003)	The role of users in the new product development process.
	Feng Peihong (2016)	The result of a joint effort between the user and the enterprise.
Behavior	Cermak (1994)	The user's effort behavior and degree in the process of service production and consumption.
	Hsieh (2005)	The extent to which users contribute and participate in production cooperation in the production or delivery process of the enterprise.

At present, there are many researches on user participation at home and abroad, mainly in the field of service. Although there are some similarities in the definition of user participation, scholars have not yet reached a consensus. This paper sorts out some representative definitions from the

aspects of value creation, relationship and behavior, as shown in Table 1 below.

The definitions of user participation from different perspectives have different emphases, but there are also some commonalities: (1) user participation is a kind of cooperation, which is a task completed jointly by users and enterprises; (2) user participation is a kind of behavior, which requires users to participate in the whole production process of products and services; (3) User participation is a kind of resource, and users can put their own knowledge and other resources into the product development of enterprises.

2.1.2. Online Community

Online Community, namely virtual community, is an innovative network community formed with the development of the Internet. Scholars at home and abroad hold different views on its definition. Rheingold first put forward the concept that online community is a collection of people who communicate with each other and share knowledge and information in the process of Internet communication.

The definition of online community mainly covers the same interest, interactive communication, network and other elements. Therefore, this paper argues that the emergence of online communities provides a platform for information exchange and interaction between network users and enterprises, through which users with the same interests can express their opinions or communicate, and enterprises can also collect users ' needs and knowledge through it.

The early research direction of domestic scholars mainly focused on the definition of online community, user behavior and so on. In recent years, it has gradually developed to the performance evaluation and industrial application of online community. Typical examples are: Liu Liqun et al., based on sociology and group dynamics, explored the factors that affect users' knowledge sharing in online communities; Xiang Haihua analyzed the impact of knowledge sharing activities in online communities on the development of e-commerce from the business field, and guided the direction of e-commerce development; Xie Xuemei constructs a model with the help of user knowledge contribution as a mediator to explore the impact of online community user participation on new product development performance.

2.1.3. User participation in product innovation

Von Hippel first proposed the definition of user participation in product innovation. He pointed out that user participation in product innovation is a new method or improvement proposed by users who have used enterprise products or services. Since he proposed this concept, user participation in product innovation has gradually become a research hotspot. Scholars at home and abroad have studied user participation in product innovation from different perspectives, and this concept has become increasingly perfect and comprehensive, as shown in Table 2 below.

From the above literature, the definition of user participation in product innovation in the past is mainly reflected in the following aspects: (1) The premise of user participation in product innovation is to meet their unrealized needs. At the same time, we should improve the products or services of enterprises, including improving existing products and developing new products. (2) User participation in product innovation is a collaborative innovation model. In addition to emphasizing user autonomy, it also attaches importance to the support of enterprises. (3) Enterprises need to properly manage user innovation resources, such as improving enterprise user innovation mechanism and creating a good innovation atmosphere for users.

Table 2. Definition of User Participation in Product Innovation

Scholar	Definition
Christine (2000)	The enterprise manages the form, stage and process of user participation, and applies the user to the product development process.
Wu Wei (2011)	User participation in innovation should include two levels: direct behavior and indirect spirit, that is, users can participate in innovation by actual action or by providing information.
Chen Xiaoping (2017)	Users who use enterprise products or services can share information through the platform provided by the enterprise, and put forward new ideas or suggestions on enterprise products or services with the help of acquired knowledge and experience to meet the needs of others or themselves.

2.1.4. Social capital theory

(1) Implications of Social Capital Theory

The theory of social capital was first used in the field of sociology, and Bourdieu gave the first definition of system. It has been widely recognized and applied to hot areas such as economics and management.

According to Yan Xiaoxia's classification, we can see that social capital emphasizes the combination of external capital and internal capital. Because social capital is a comprehensive point of view, the division of social capital dimensions should also be divided from multiple dimensions. This paper draws on Nahapiet and Ghoshal's three-dimension model (structural, cognitive and relational dimensions), which is generally accepted by the academic community. Among them, the structural dimension emphasizes the network structure, nodes and appropriate organization; The cognitive dimension emphasizes shared language, context, and values; The relationship dimension emphasizes trust, recognition and rules.

Although the three-dimension model is widely used in the research of social capital, each dimension contains different variables. This paper argues that social capital is available through social relationships, which are resources that function based on the individual's ties in the group, and uses the four most common variables (image maintenance, self-efficacy, community recognition and community influence) to measure social capital.

(2) The Applied Research of Social Capital Theory

Chinese scholars' research on social capital theory mainly focuses on the field of physical environment and virtual community. For example, in order to explore the relationship between social responsibility and corporate performance, Cheng Quan (2012) studied the relationship between social capital and knowledge sharing in online communities, and improved the effectiveness of knowledge sharing in online communities. Yang Shuang and Zhou Xing (2010) found that social capital affects online word-of-mouth and information search, thus interfering with users' desire to buy. However, there are few studies on the combination of social capital with knowledge sharing and innovation. For example, Tang Jingjing (2015) proved that knowledge sharing plays a conductive role in social capital and individual innovation behavior, but did not continue to explore the relationship between social capital and individual innovation behavior.

2.2. User participation and innovation in the millet community

Millet community is a platform for millet users to communicate, which was officially launched on August 1, 2011. After continuous development, millet community is now not only the headquarters of "rice noodles", but also one of the largest online communities in China. Here, users are free to share experiences about playing and resources, search for other people's experiences to share, and communicate with developers to improve their systems. Xiaomi users and potential users participate in product innovation and discussion in online discussion boards-circles. These "rice noodles" have made significant contributions to the development and testing of millet mobile phones and systems, providing many ideas, and some will also provide improved methods and code. This development mode of operating system improvement based on the Internet is the first in the mobile Internet operation industry, which greatly improves user stickiness and satisfaction, and ultimately increases the number of users and promotes the development of enterprises.

The development team of Xiaomi Community will provide timely feedback on user suggestions, review valuable user sharing experiences, comment on questions and suggestions and make formal responses, and mark different treatments on the post homepage, such as "included", "replied", "established", etc.). It improves product performance, stimulates users to participate in innovation, and improves users 'satisfaction and sense of achievement.

In the millet community, users participate in the development of new products mainly in the following ways:

(1) Share product experience and service experience

Most of the users in the circle are users or potential users of the millet community, and they all have the same practical experience or hobbies. They often share experiences within the circle and discuss relevant topics about product use. These contents will have a chain reaction to many potential users, which will lead them to experience the products or services of the enterprise.

(2) Point out the problems and dissatisfaction found in the use of products or services.

Users raise their own problems or dissatisfaction in the circle, so that enterprises can know the needs of users in time and solve problems better. Although this negative problem may cause the loss of potential users, it may also cause existing users to lower their evaluation of the product. But millet through the establishment of professional groups, timely response to user questions, not only will not produce the above problems, but become an alternative way of millet publicity services. In addition, users spend energy to raise their own problems or dissatisfaction, indicating that they are still interested in millet products, want to solve these problems, make millet products better. Therefore, the timely and effective response of enterprises will close the distance with users, improve the loyalty of users, and let more loyal users spare no effort to ask questions or suggestions.

(3) Propose solutions to problems or suggestions for product improvement

When some users with professional knowledge and ability find problems, they will put forward solutions or suggestions for the problems. This kind of post or reply can not only provide other users with solutions to problems, but also communicate directly with millet development team members through community forums, so that enterprises can really grasp the needs of users and respond at the first time.

(4) Put forward innovative ideas and participate in the development of new products or services

Millet applies innovative ideas about products or services in user posts to the development of products and services, and guides users to participate in product development. Even some users directly implement innovative development on the basis of putting forward ideas, provide improvement methods or codes, and fully contribute to the user's strength.

3. Research hypothesis and model construction

3.1. Research Hypothesis

3.1.1. The relationship between social capital and knowledge contribution

This paper divides the three dimensions of social capital into structural capital dimension, cognitive capital dimension and relational capital dimension. Among them, centrality is used to measure the structural capital dimension, self-efficacy to measure the cognitive capital dimension, and community recognition and community influence to measure the relational capital dimension. If enterprises want to develop new products through online communities, they need to encourage more users to actively contribute their existing knowledge, drive online community members to create more new ideas and knowledge for enterprises, and promote better development of enterprises.

(1) The Relationship between Structural Capital Dimension and Knowledge Contribution

According to the theory of social capital, in the collective, people interact with each other through connections. The online community formed by communication will make the connection closer and make the interactive behavior easier. One of the purposes for users to actively participate in community activities is to gain the recognition and respect of other users. Li Junting (2015) believes that members participate in online communities in order to enhance their status in the community, that is, centrality. Centrality is an important indicator of structural capital, which is the status of users in the hearts of other users in the virtual community. Therefore, there is a direct and close relationship between knowledge contribution and user image maintenance in online communities. Rogers and Kincaid (1981) suggested that the more central an individual is, the more likely he is to contribute to the organization. Wasko and Faraj (2005) confirmed that the higher the centrality of users, the more knowledge they will contribute, and will also drive other users to contribute to knowledge.

By actively participating in online community activities, users can not only maintain their own image, but also improve their hierarchical status in the community. In this paper, the centrality of a user is measured by its connections with other users. In the millet community, users communicate with each other by asking and answering questions. The number of replies reflects their centrality in the community, and then affects the willingness of users to contribute knowledge in the community. The platform will give users different titles according to their performance in the community. The higher the level, the more permissions the user gets, and the higher the authority it represents. Therefore, in order to get a higher level, users usually earn activity by posting replies. For high-level and authoritative posts, it will create a sense of trust for other users, and other users will be more willing to reply. For

users who post, getting more replies is virtually a trust and recognition of their knowledge, ability and other aspects, and will also encourage these users to constantly create new knowledge for the community regardless of return and dedication. Based on this, this paper puts forward the following assumptions:

H1: Centrality has a positive effect on knowledge contribution behavior.

(2) The Relationship between Cognitive Capital Dimension and Knowledge Contribution

Cognitive capital is a necessary condition for knowledge sharing among online community users, that is, those resources that contribute to knowledge sharing, such as common language, experience knowledge, values, common vision, etc. Community users get cognitive capital from the interaction with other users or the experience imparted by other users, and the voluntary nature of users drives the occurrence of knowledge contribution behavior. When users think that their cognitive capital is less, their willingness to contribute knowledge will be reduced accordingly, knowledge contribution behavior will not occur smoothly, and enterprise product innovation will be hindered. In this paper, cognitive capital is measured by users' self-efficacy.

Self-efficacy is a user's sense of self-related abilities, including the experience and skills gradually formed through the exchange of activities in the community. According to Cabrera (2002), users' self-efficacy can improve their willingness to participate and promote users to actively share knowledge. Hsu et al. (2007) have proved that self-efficacy has a positive effect on users' knowledge sharing behavior. In online communities, if a person wants to share knowledge with others, he must first have the necessary cognitive capital and certain self-efficacy, that is, people with higher self-efficacy are more likely to put forward useful opinions in the community. Therefore, users with higher technical ability and stronger knowledge needs will contribute more knowledge. Therefore, the following assumptions are put forward:

H2: Self-efficacy has a positive effect on knowledge contribution behavior.

(3) The Relationship between Relational Capital Dimension and Knowledge Contribution

According to other scholars' definition of relational capital, this paper uses community recognition and community influence to measure the dimension of relational capital.

(4) Community recognition

According to Nahapiet and Choshal (1998), community recognition is a user's sense of presence as a collective member in an online community and a sense of belonging resulting from communicating with other users. Social exchange theory also mentions that when individuals improve their status in the collective through knowledge contribution, they are more willing to contribute knowledge in order to win recognition. Scott (2012) believes that in open innovation communities, when users feel the recognition of other users for their innovation, their willingness to participate in the community is stronger, and they are more likely to actively share knowledge and produce innovative behavior. In the millet community, other users realize the recognition of the user through praise. This process is an interactive process and a positive feedback, which helps users to understand the basic information such as the research fields covered by the community, create a strong atmosphere of knowledge sharing, and promote other users to participate in knowledge contribution. For users who post, getting praise can satisfy their inner sense of achievement and promote users to participate more in the community to produce knowledge contribution behavior. Therefore, the following assumptions are made:

H3: Community recognition has a positive impact on knowledge contribution behavior.

(5) Community influence

Community influence is the interaction between users and the degree of influence of individuals on other members of the community. Chai et al. (2011) pointed out that social intensity has a positive impact on users' knowledge sharing. That is to say, social networks have a positive impact on users' initiative to share knowledge. The greater the influence of users, the more attention they attract. New users who join the community first browse the posts of other users to deepen their understanding of the community, and then gradually find other community users who resonate with them, and gradually enhance their willingness to contribute knowledge. Similarly, users with high community influence will have a stronger sense of pride, so that they have a stronger confidence in the knowledge they share, will be more active to post, reply, and produce knowledge contribution behavior. Therefore, the following assumptions are made:

H4: Community influence has a positive effect on knowledge contribution behavior.

3.1.2. The relationship between knowledge contribution and user participation in product innovation

Online community is a virtual knowledge interactive learning platform, and the product innovation of enterprises can come from the knowledge innovation of the community, which cannot be separated from the interactive behavior of community users. Knowledge innovation is produced in interaction, so the results of innovation will be different because of different objects and environments. Huang Guanwei (2007) believes that community knowledge innovation is closely linked to user learning, knowledge exchange and sharing, and these community activities are based on an open and positive community culture. Xie Xuemei (2019) confirmed that high-quality user knowledge contribution will improve the degree to which user knowledge is transformed into new product development performance. This paper argues that the more the number of knowledge contribution, not only enrich the knowledge source of the community, but also have a greater influence on other users, prompting other users to generate new ideas and participate in the development of new products. Therefore, the following assumptions are made:

H5: Knowledge contribution behavior positively promotes user participation in product innovation.

3.1.3. Mediating role of knowledge contribution

In the field of virtual communities, in order to verify the relationship between network innovation performance and social capital, some scholars introduce the absorptive capacity of knowledge as a mediating variable. Li Junting (2015) analyzed and verified that knowledge contribution behavior has a certain mediating role in social capital and virtual community knowledge innovation. The greater the number of knowledge contributions and the richer the knowledge sources of the online community, the newer ideas are likely to be available for enterprises to innovate products. In the millet community, users can provide more proposals and suggestions on functions, use and other aspects to the R & D team from their own point of view through personal experience. The more proposals and suggestions, the more

posts will be included by the R & D team. To sum up, this paper puts forward the following assumptions:

H6: Knowledge contribution behavior plays a mediating role between structural capital and user participation in product innovation.

H7: Knowledge contribution behavior plays a mediating role between cognitive capital and user participation in product innovation.

H8: Knowledge contribution behavior plays a mediating role between relational capital and user participation in product innovation.

3.2. Setting of model study variables

3.2.1. Independent variable setting

On the basis of reading a large number of literatures, this paper redefines the independent variables under the three dimensions, and puts forward four different influencing factors, namely, image maintenance factor, self-efficacy factor, community recognition factor and community influence factor.

(1) Centrality

Centrality refers to the user's position in the online community. The higher the centrality, the higher the user's status and ability. Who has high centrality is recommended by other users. In the millet community, users get attention or help from others by posting posts to share their experiences, knowledge or help questions. The more professional the post is, or the more widely accepted the question is by other users, the more users will be attracted to reply to the post. The more posts you reply to, the more you approve of the content posted by the posting user. In this paper, the number of replies to user posts is used as an indicator of centrality, and the more the number of replies, the higher the centrality.

(2) Self-efficacy

The ability of an individual to produce a certain behavior and achieve the expected results is called self-efficacy. This is the subjective judgment of the individual and the perception of the individual's self-related abilities. According to social cognitive theory, people's behavior will affect their own cognition. Users propose solutions as a recognition of their ability to help others solve problems. Therefore, this paper intends to select the number of posts proposing solutions to represent the user's self-efficacy.

(3) Community recognition

Community recognition is the feedback of others on their behavior, the sense of existence of users as collective members in online communities and the sense of belonging generated by communication with other users. After browsing the post, other users will express their preferences for the post by liking it. Therefore, this paper selects the number of likes from other users to express the recognition of the user's posts.

(4) Community influence

Community influence is the interaction between users and the degree of influence of individuals on other community users. Each post will display the total number of views of the post so far, and the number of views of the post can intuitively show the attention of other users. Therefore, this paper selects the average page views of the posts posted by users to represent the community influence of users.

3.2.2. Intermediary variable setting

Knowledge contribution refers to the number of answers to the questions that users know, which can be expressed in the form of publishing posts. Users in the millet community are mainly users or enthusiasts of millet products. Users have relevant experience and are the main body of knowledge generation. Users actively publish posts to exchange their experience in the use of products or participate in discussions on specific topics to make the whole community operate normally. Therefore, this paper selects the number of articles published by users to represent the knowledge contribution of users.

3.2.3. Dependent variable setting

User participation in product innovation means that users share information through the online platform provided by enterprises, and rely on available knowledge and experience to put forward new ideas or suggestions for the products or services of enterprises to meet the needs of others. In the millet community, developers and community workers are stationed in the circle to reply to the questions raised in the posts posted by users, while most of the replies from ordinary users are evaluative replies to the content of the posts. For constructive ideas put forward by users, developers will include them to help enterprises create new products or provide better services. Therefore, this paper selects the posts included by developers to represent users to participate in product innovation.

4. Data Analysis and Model Validation

4.1. Data collection

This paper takes the millet community circle as the research target, and its online users as the research object. Millet community currently has several sections such as square, circle, millet mall and so on. Among them, the circle is the place for millet users to communicate online, mainly including mobile phones, MIUI systems, application games, games, rice noodle circles, daily life, cool play, computers/headphones, TV, smart life and home appliances and other communities. The most popular communities are millet mobile phone circle, millet 10/10 Pro, MIUI system and so on. Among them, the community with the highest degree of participation in discussion and the largest number of members is the MIUI system section.

Each plate is divided into several parts according to the content of the plate, mainly for the essence, proposals, suggestions, etc. Among them, the suggestion plate is an open test platform for products. Users can not only put forward problems encountered in the use of mobile phones, systems and other millet products, but also put forward suggestions for products, directly propose solutions for enterprise product innovation and new product development, and participate in production cooperation. In addition, users can also exchange their feelings here, solve problems for other users, and understand the latest developments of millet. As the operating system of millet mobile phone, MIUI system exists in all millet mobile phones, with a large number of active users and a large number of user participation behavior in the plate. Therefore, through comprehensive consideration, the online users of the "MIUI" section in the millet community are selected as the research objects.

4.2. Data analysis

4.2.1. Descriptive statistical analysis of samples

Descriptive statistics of the processed variables are firstly carried out in this paper, his article crawls the data of 15 days from 0 o'clock on April 4, 2020 to 24 o'clock on April 18, 2020.

As can be seen from the table, the average number of

articles published by millet community in the past 15 days is 510.33, the average number of articles suggested by users is 85.53, and the average amount of articles included is 71.40. The maximum number of articles published on that day was 580, the minimum was 444, the maximum number of articles suggested by users was 107, the minimum was 70, and the maximum number of included articles was 91, and the minimum was 49.

Since panel data with multiple time series is used in this paper, the descriptive analysis is conducted by using the time point section of April 18, 2020.

We can see that the average number of likes is 2.62, the average number of comments is 2.06, and the average view of each post is 57. Among them, the article received 138 likes at most and 0 at least, and 46 comments at most and 0 at least. It can be seen that some users in this circle seldom publish articles. It is worth noting that the maximum number of views is 6306, but the maximum number of likes is only 138, indicating that there are fewer high-quality articles, and some articles have no likes.

4.2.2. Correlation analysis

In statistics, in order to determine whether there is a correlation between variables, the most commonly used statistical method is called correlation analysis. Its measurement index is the correlation coefficient R, which is in the range of -1~1 Between, r>0 Indicates a positive correlation between variables, r<0 Is expressed as a negative correlation. Generally, the Person correlation method is selected for two-tailed test. If the two-tailed significance probability Sig>0.5, indicating that there is no significant correlation between the tested variables; Sig<0.05, indicating a significant correlation between variables; Sig<0.01, indicates significant correlation between variables.

(1) The Correlation Analysis of Social Capital and Knowledge Contribution

The results of Pearson correlation analysis using SPSS Statistic 19.0 are shown below. The table shows the significance probability values of the number of comments and the number of suggested articles. Sig.=0.00815, reaching a significant correlation at the 0.01 level, with a correlation coefficient of 0.653. This shows that the correlation between centrality and knowledge contribution is positive.

Significance probability value of the total number of articles and the number of suggested articles Sig.=0.02915, reaching the correlation at the 0.05 level with a correlation coefficient of 0.563. This shows that the correlation between self-efficacy and knowledge contribution is positive.

Significance Probability Value of the Number of Likes and Suggested Articles Sig.=0.00015, reaching a significant correlation at the 0.01 level, with a correlation coefficient of 0.884. This shows that the correlation between community recognition and knowledge contribution is positive.

Significance Probability Value of Number of Views and Number of Suggested Articles Sig.=0.00015, reaching a significant correlation at the 0.01 level, with a correlation coefficient of 0.798. This shows that the correlation between community influence and knowledge contribution is positive.

Through the above correlation analysis, it can be seen that the significant probability value of the number of likes is the smallest, and it has the largest correlation coefficient, indicating that the correlation between community recognition and knowledge contribution is stronger. Therefore, the higher the pursuit of community recognition, the more likely the knowledge contribution behavior will occur. Generally speaking, the three dimensions of social capital are all related to knowledge contribution behavior, and the size of the correlation is different.

(2) Correlation Analysis of Knowledge Contribution and User Participation in Product Innovation

Significance probability value of the number of articles included and the number of articles recommended Sig.=0.00015, reaching a significant correlation at the 0.01 level, with a correlation coefficient of 0.831. This shows that the correlation between knowledge contribution and user participation in product innovation is positive.

4.2.3. Regression analysis

(1) Regression Analysis of Social Capital and Knowledge Contribution

This paper uses Baron's causal regression method to construct a regression equation, in which the dependent variable is knowledge contribution, and the predictive variables are four factors: centrality, self-efficacy, social recognition and social influence.

In the model, the t-test significant probabilities of the constant term and centrality are 0.000 and 0.008, respectively, which are less than 0.05 and can enter the regression equation. Therefore, the standard regression equation is: knowledge contribution =71.594+4.477* centrality.

In the model, the t-test significant probability of self-efficacy is 0.029<0.05, can be entered into the regression equation. However, the t-test significant probability of a constant term is 0.793>0.05. The constant term cannot be included in the regression equation. Therefore, the standard regression equation is: knowledge contribution =0.151* self-efficacy.

In the model, the t-test significant probability of the constant term and community approval is 0.000<0.05, can be entered into the regression equation. Therefore, the standard regression equation is: knowledge contribution =68.509+3.966* Community Recognition.

In the model, the t-test significant probability of the constant term and community influence is 0.000<0.05, can be entered into the regression equation. Therefore, the standard regression equation is: knowledge contribution =77.772+0.043* social influence.

This shows that centrality, self-efficacy, community recognition and community influence are all linear regression in knowledge contribution.

(2) Regression Analysis of Knowledge Contribution and User Participation in Product Innovation

In this analysis, the dependent variable is user participation in product innovation, and the predictor variable is knowledge contribution.

In the model, the t-test significant probability of knowledge contribution is 0.000<0.05, can be entered into the regression equation. However, the t-test significant probability of a constant term is 0.929>0.05. The constant term cannot be included in the regression equation. Therefore, the standard regression equation is: User participation in product innovation =0.737*Knowledge Contribution. This shows that the knowledge contribution of mediating variables is linear regression on user participation in product innovation.

4.2.4. Analysis of mediating effect of mediating variables

In order to prove the mediation effect of knowledge contribution, this paper borrows the mediation regression method of Baron and Kenny. Firstly, the regression of the mediating variable (knowledge contribution) on the independent variable (social capital) is tested. Secondly, the

regression of the dependent variable (user participation in product innovation) on the independent variable (social capital) is tested. Finally, it is shown that the dependent variable (user involvement in product innovation) can be forced to regress on the mediating variable (knowledge contribution).

If the three dimensions of social capital can significantly affect knowledge contribution and user participation in product innovation, knowledge contribution will significantly affect user participation in product innovation, and the impact of the three dimensions of social capital on user participation will be weakened. It shows that the mediating effect of mediating variable (knowledge contribution) is significant.

When this condition is met, if the influence of the independent variable on the dependent variable is significantly weakened and is not significant, it means full mediation, and if it is significant, it means partial mediation. Therefore, we first seek the regression of the dependent variable (user participation in product innovation) on the independent variable (social capital), and then make a forced regression of knowledge contribution on user participation in product innovation.

By comparison, it can be seen that after adding the intermediary variable knowledge contribution, the t-test significant probability of each factor has changed. Among them, the t-test significant probability of centrality changed from 0.041 to 0.939, and the significance became insignificant. The significant probability of t-test of self-efficacy changed from 0.016 to 0.002, and the significance was still significant. The t-test significant probability of social acceptance changed from 0.001 to 0.738, and the significance changed to non-significant. The t-test significant probability of social influence changed from 0.01 to 0.319, and the significance became weaker. The regression coefficients of each factor have also changed. The significance of centrality, self-efficacy, social recognition and community influence changed from weak to insignificant, indicating that knowledge contribution plays a mediating role between these factors and user participation in product innovation.

4.3. Analysis of research results

Based on the theory of social capital, this paper analyzes the motivation of user participation in the process of new product development.

(1) Centrality will promote users to participate in new product innovation. Through data analysis, the P value between the number of comments and the number of recommended articles is 0.653, and there is a positive correlation between them. The P value between the number of recommended articles and the number of included articles was 0. 831, which was positively correlated, and the mediating effect of the number of recommended articles was significant. The more comments, the more attention other users pay to the article, which will attract more views and attention for users, which invisibly improves the status of users in the community and improves the centrality. In collective life, everyone is willing to pursue leadership or central position. Therefore, they will make efforts to enhance their prestige. In online communities, the social status of users can be measured by ranking, comments, points and other indicators. Users with higher centrality will receive more attention, and they need to publish more articles to maintain their status. Similarly, when users feel that their knowledge contribution will win the recognition and attention of others and even enterprises, they will be more willing to take the initiative to contribute knowledge and provide innovative sources for enterprises.

(2) Self-efficacy promotes users to participate in new product innovation. Through data analysis, the P value between the total number of articles and the recommended number of articles is 0.563, and there is a positive correlation between them. The P value between the number of recommended articles and the number of included articles was 0. 831, which was positively correlated, and the mediating effect of the number of recommended articles was significant. Self-efficacy is a user's self-perception of his own ability. It can be seen that the more articles published, the stronger the user's self-efficacy. In online communities, users will not only ask questions about the use of products, but also some high-level users will give some technical answers. These high-quality answers help enterprises to draw ideas and ideas from them and better develop products that users need.

(3) Community recognition promotes users to participate in new product innovation. Through data analysis, the P value between the number of likes and the number of suggested articles is 0.884, and they are positively correlated. The P value between the number of recommended articles and the number of included articles was 0. 831, which was positively correlated, and the mediating effect of the number of recommended articles was significant. This shows that other users' response and recognition to the user will make them feel proud and satisfied, and they are more willing to publish their views in the online community. Users express their recognition by praising each other, which is an interactive way of communication between users. The recognition expressed by praise will make users think that their knowledge contribution is valuable, generate a sense of responsibility for the online community, and will be more willing to devote energy to doing things that are beneficial to the online community or enterprises, and then put forward their own views in the community. The more opinions and suggestions users put forward, the more innovative sources enterprises can draw valuable ideas from them and apply them to product development or innovation.

(4) Community influence promotes users to participate in new product innovation of enterprises. Through data analysis, the P value between the number of views and the number of suggested articles is 0.798, and they are positively correlated. The P value between the number of recommended articles and the number of included articles was 0. 831, which was positively correlated, and the mediating effect of the number of recommended articles was significant. This shows that when the number of visits to the article increases, more users will be able to pay attention to it, and the high number of visits to the article will also make other online community users have a sense of trust in the content of the article. Therefore, the high number of visits will make the users who publish articles feel satisfied and give themselves a kind of affirmation, which will increase the knowledge contribution behavior of users. By expanding the number of posts or improving the quality of articles, we can attract more users to visit.

5. Conclusion

5.1. Research conclusion

Through the above analysis and research, this paper proves that in the online community environment, the three

dimensions of social capital have a certain impact on users' contribution to knowledge and their participation in new product development. The following conclusions are drawn:

(1) Social capital has a positive impact on users' knowledge contribution in online communities. The three dimensions of social capital have an impact on the knowledge contribution behavior of online community users. Through empirical research, this paper confirms that centrality, self-efficacy, community recognition and community influence are all important factors affecting user participation in online communities. High centrality, high community recognition and high community influence can improve the sense of belonging of users in the community, make them participate in community activities more actively, and enrich community knowledge sources. Users with high self-efficacy will have strong confidence in their own abilities, and their suggestions will be more professional, which will improve the quality of knowledge in the online community and help enterprises to collect information in the community more efficiently for new product development.

(2) The knowledge contribution of users in the community has a positive impact on user participation in product innovation. Users provide enterprises with knowledge contribution process of product development ideas, that is, the process of participating in online communities. The more suggestions users provide in the community, the richer the innovation source of enterprises, and the more ideas enterprises can adopt. This can shorten the product development cycle, reduce development costs, improve product quality and meet user needs.

(3) The mechanism of social capital on user participation in product innovation. From the results of this study, social capital affects user participation in product innovation through knowledge contribution, and knowledge contribution also plays a mediating role in the process of influence. However, for different indicators, there are different degrees of effect. This phenomenon reflects the complexity of social capital in the study of new product development of online community enterprises.

5.2. Management Suggestions

As more and more users participate in the development of new products, this model has become an important strategy for enterprises. Based on the research results, this paper puts forward the following suggestions for the new product development of enterprises:

(1) Continuously adjust the community incentive mechanism to discover the leading users in the online community. The empirical results show that the centrality will affect the amount of user knowledge contribution, and then have an impact on participation in product innovation. Therefore, the community uses measures such as issuing grade points, exchanging points, drawing lottery, and allowing help-seeking users to thank the respondents according to their abilities to encourage users to focus on centrality and specialization of knowledge content. This not only encourages users to actively speak in the community to maintain their status in the community, but also guides new users to better target. For the discovery of leading users, mutual recommendation among community members can be used to invisibly establish recognition among users, which is very helpful for users to contribute knowledge.

(2) Strengthen the personalized recommendation of community users. For the low participation of some users in the community, enterprises can use big data to analyze the content that users have participated in, judge their possible needs, and then recommend relevant topics. Users are more likely to put forward specific suggestions for enterprises when browsing the sections, they are interested in, which improves user loyalty and satisfaction while enhancing user participation in the community, and improves the success rate of new product development.

(3) Provide clearer and clearer web services. Enterprises should pay attention to the ease of use of online communities while improving online communities. The plate structure is clearly divided, the search technology is convenient, the content of the plate is rich, and the communication is fast and convenient, so that users can quickly integrate into the community atmosphere, while continuing to participate in the community.

(4) Enterprises should improve their ability to transform user knowledge. Users provide knowledge, and the process of enterprises transforming user knowledge into new products is the essence of user participation in innovation. In online communities, enterprises reply to users ‘suggestions in time, which not only solves the problems of posting users and improves users' satisfaction, but also makes other users believe that their innovations can be adopted by enterprises and encourages them to participate in product innovation. Finally, for the product suggestions provided by users, enterprises also need to improve their transformation ability and transform them into new product development solutions.

5.3. Research deficiency and prospect

Although this article has proved the hypothesis through the real diagnosis, but because the condition limit and own ability are limited, this article also is unable to achieve the ideal condition, has the following insufficiency.

(1) This paper only selects 15 days of panel data to study, the amount of data is small, and there may be occasional cases. If the data collection cycle continues to be extended, the user data will be more complete.

(2) Due to the limitation of conditions, the data crawled in this article comes from the web version of millet community. However, in the millet community mobile APP version, the user data is more comprehensive, including the user level, the number of user participation circles, the number of fans and other information, which will have a more obvious impact on the study of the impact of various dimensions of social capital on user participation in new product innovation. Therefore, the next step is to try to crawl mobile APP data and improve data sources.

(3) This paper studies the impact of three dimensions of social capital on user participation in product innovation, but there are other factors in the process of user participation, such as altruism, hedonic motivation and other factors have not been verified in this paper. Therefore, future research can enrich the measurement indicators of various dimensions of social capital theory and improve the motivation of user participation.

(4) Because of the single research object, this paper takes the millet community circle as the research object, but different online communities may have different user participation behavior, and the incentive policy of the community for user participation will also be different. Therefore, future research can diversify the choice of online communities, analyze the influencing factors of user participation in new product innovation in multiple online

communities, and find the universal law of these factors.

References

[1] Laage-Hellman, J., Lind, F., Perna, A.. Customer Involvement in Product Development: An Industrial Network Perspective. Journal of Business-to-Business Marketing, 2014, 21(4): 257-276.

[2] Crawford, C. M., Di Benedetto, C. A.. New Products Management (10th Ed.). Boston, MA: McGraw-Hill Irwin, 2011.

[3] Ritter, T., Walter, A.. Relationship-Specific Antecedents of Customer Involvement in New Product Development. International Journal of Technology Management, 2003, 26(5/6): 482-502.

[4] Rheingold H. The virtual community: Finding commection in a computerized world[M]. Addison-Wesley Longman Publishing Co., Inc., 1993.

[5] Hagel J, Armstrong A G. The real value of on-line communities[J]. Harvard Business Review, 1996, 74(3): 134-141.

[6] Leal G P A, Hor-Meyll L F, de Paula Pessôa L A G. Influence of virtual communities in purchasing decisions: The participants' perspective[J]. Journal of Business Research, 2014, 67(5): 882-890.

[7] Eric von Hippel, The Source of Innovation, Oxford University Press, 1988.

[8] Molly McLure Wasko,Samer Faraj. Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice[J]. MIS Quarterly,2005,29(1).

[9] Rogers, E., and Kincaid, D. Communication Networks: Toward a New Paradigm for Research [M]. The Free Press, New York, 1981.

[10] Elizabeth F. Cabrera,Angel Cabrera. Fostering knowledge sharing through people management practices[J]. The International Journal of Human Resource Management,2005,16(5).

[11] Meng-Hsiang Hsu,Teresa L. Ju,Chia-Hui Yen,Chun-Ming Chang. Knowledge sharing behavior in virtual communities: The relationship between trust, self-efficacy, and outcome expectations[J]. International Journal of Human - Computer Studies,2006,65(2).

[12] Janine Nahapiet,Sumantra Ghoshal. Social Capital, Intellectual Capital, and the Organizational Advantage[J]. Academy of Management,1998,23(2).