ORAGANIZATIONAL INNOVATION ABILITY IMPROVEMENT DURING CONCEPT DESIGN PHASE BASED ON USER COLLABORATIVE INNOVATION FOR ELECTRICAL APPLIANCE

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Abstract

In the process of enterprise product innovation, both the lead user method and collaborative innovation method are the new methods of product innovation in the industry. How to combine these two methods to better manage enterprise product innovation is a blank research field in the academic field. How to better find the lead users, mining the ideas of the lead users, how to manage the ideas of the lead users in the enterprise, how to combine the ideas of the lead users' ideas and experts' ideas to extract more innovative product concepts, so as to achieve the product innovation of the enterprise, these are important management elements of product innovation management. Which of these management elements have a significant impact on enterprise product innovation, and how they relate to each other is the focus of this paper.

Keywords: User Collaborative Innovation, Organizational Innovation Ability, lead user, collaborative innovation, Customer Competence of Lead User, User Insight, Conceptual collaborative innovation competence, Conceptual Decision-making Competence, Innovative Leadership, User Pain Point and Demand, Produce Concept.

Introduction

1. Statement and significance of the problem

Since the world economy entered 2022, more and more innovative ideas and innovative thinking have been widely mentioned, and a variety of innovative methods have been applied in the development of new products, which has brought a positive impact on the innovation of enterprises. According to the research of scholars, the higher the degree of product innovation of a company and the more it meets customer needs, the more it can lead the market, and the degree of innovation of a company is closely related to its development (Yu Dengke et al., 2018). At the same time, the ability to design innovative products that meet customer needs is the core competence of an enterprise (Ling Jinru et al., 2000), which is reflected in many market factors such as brand power, product competitiveness, consumer trust and product premium power (STOREY C,2018). The view that innovation ability is the core ability of enterprises has been recognized by the society (Yao Shanji et al., 2012), and scholars have proposed that innovation ability is the primary productive force (Hou Shusen, 2003). More and more managers have realized the importance of innovation. Many managers try to mobilize the company's design resources and change management methods in the hope that the product can stand out from the competition and lead the market.

In the academic field, Demil B et al (2012) put forward the collaborative innovation method, which utilizes external resources including advanced knowledge and experience to participate in the process of product design development and improve the innovation power of enterprises (Saunière J C et al.,2013) (Toillier A et al.,2018) also mentioned how to use teams to achieve collaborative innovation. The essence of collaborative innovation is to integrate external resources with internal resources to achieve product innovation, among which external

resources include university scientific research, industry experts, state agencies and leading users. Internal resources include the original company's user research team, project development team, project research and development funds, etc. (Anzola-Roman P et al., 2019). Common integration methods of resource integration include digital platform integration, team cooperation development, project leading subject change, etc. Collaborative innovation emphasizes the integration of external resources and internal resources, and emphasizes the integration method, innovation driving mechanism, knowledge transfer mode, etc. However, in the process of collaborative innovation, the internal management mode of the company and how to allocate the supporting management resources can better assist innovation, this aspect still needs further management research.

Among external resources, the lead user is one of the important resources. C. Luthje (2004) proposed the lead user method, which utilizes the advanced knowledge and experience of the lead user to participate in the process of product design development. Improving the innovation capacity of enterprises (A. Chatterji, and K. Fabrizio, 2014). (Glen L. Urban, 1988) pointed out that the use of advanced user perception to predict the future needs of ordinary users can help enterprises develop products faster. At the same time (Cornelius Herstatt,1992) proposed that developing products in collaboration with leading users could accelerate the process of new product development and greatly reduce the development cost of enterprises (Chang, W et al.,2016) proposed that using leading users to develop new products. Can improve the organization's financial returns. At the same time (Huang Manhui et al.,2017) proposed that user participation can greatly improve the department performance of enterprises. In conclusion, the participation of leading users in the product development process can greatly improve product innovation (HOYER W D et al.,2013). This paper focuses on the consumer electronics industry, in which it is a huge challenge for enterprises to find leading users. According to the characteristics of leading users proposed by Eric von Hippel (2005), they are rich in knowledge, willing to share and willing to learn. (Guozheng He et al.,2024) proposed that leading users should possess the following three characteristics: 1) Knowledge and skills, 2) Willingness to learn and experiment, 3) Ability to engage in an active dialogue. This has provided guidance for the definition of leading users. However, for enterprises, it is worth studying how to select and find leading users among numerous users. The characteristics of leading users can significantly affect the innovation of enterprises, which is also lacking in relevant research in the academic field. In addition, what kind of user characteristics can be defined as leading users, and what kind of user characteristics can be more conducive to enterprise innovation, there is a lack of practical research in the entire academic circle. At the same time, for enterprises, how to find leading users has become a kind of ability, which dimensions can reflect this ability, and how these dimensions affect the user co-creation ability of enterprises, but also lack of certain practical experience. Finally, every enterprise has its own established product development process. According to Pahl et al (2007), the product development process of an enterprise can be roughly divided into four stages: Demand research stage, the demand analysis stage, technical design and detailed design, in the first three stages, the idea of leading the user needs to combined with the enterprise, can play the role of lead users. How to integrate the ideas of leading users into the enterprise development process is worth studying and thinking about. Any enterprise has system inertia for the original development process and development system, and the leading user method as a new method will destroy the product development process of the enterprise. How to better integrate the innovative ideas of users into all aspects of enterprise product development? How to ensure that the ideas of leading users can smoothly enter the inspiration of product design is also worth studying and in-depth discussion.

Lead user method and user collaborative innovation method also face management difficulties when they are used together. How to set up supporting services to ensure that the

ideas of leading users can be directly transmitted to product innovation? The management of the company has its own processes and decision-making methods. How to transfer the ideas of leading users to the decision-making level and how to ensure that the decision-making level can effectively retain the ideas of leading users? Many companies' new product development decisions are directly decided by company executives. How can the ideas of the leading users effectively influence the executives, and what are the key process nodes and key management elements? What is the impact weight? It has certain research value in the academic circle.

Finally, how the company's supporting user mining resources can more effectively mine the ideas of leading users is the management ability of the enterprise itself. Consumer electronics companies use the method of household interview to mine the ideas of users. Most enterprises use the field work method (Chai ZhenRong, 1994) to conduct interviews. Which elements in the interview process affect the results of the interviews, and which characteristics of the investigators have significant effects on the results? Finding good leading users and mining good concepts are two dimensions, one is the inherent knowledge of leading users, the other is the ability to explore knowledge, these two capabilities are indispensable, only cooperate with each other, in order to enable enterprises to really dig a good concept of differentiation. How to conduct better interviews in order to explore more users' ideas is another important ability of an enterprise's innovation ability, and those interview features will affect users' thought mining ability. It is necessary to conduct in-depth discussion and research.

To sum up, the entire consumer electronics market, with the continuous segmentation and diversification of consumer demand, more and more subcategories are born in the market, which leads to the market segments facing innovation challenges, such challenges may come from innovators in the industry or from cross-industry innovators, which are specifically manifested in the emergence of niche brands and product diversification. In the current market competition environment, if you fail to make breakthroughs in market segments, you will be eliminated by the market. Therefore, user insight and demand research in market segments have become particularly critical, and the common method for insight is user research. Therefore, the method of leading users can be integrated into the method of user research to improve the effect of research and allow leading users to participate in product development. It also involves the concept of collaborative innovation, which has certain interoperability with collaborative innovation in management. The two methods can be combined to achieve better product design. However, in the concrete implementation, there are many difficulties, mainly reflected in how to find the leading users, how to effectively interview the leading users, and how to screen the researched concepts and how to effectively use them. How to integrate into the product design and development, are worthy of study in the field.

1.2 Research Objectives

(1) To create the factor model of Customer Competence of Lead User, User insight, Conceptual Collaboration innovation competence, Conceptual Decision-making competence, Innovative Leadership and user collaborative innovation.

(2) To test the model of User collaborative innovation with factors.

(3) To explain the relationship between User collaborative innovation and Customer Competence of Lead User, User insight, Conceptual Collaboration innovation competence, Conceptual Decision-making competence, Innovative Leadership.

Literature review

Theoretical basis

1.2.1 Collaborative innovation theory

Collaborative innovation can be defined as the use of external resources (Li Zu Chao et al, 2012), through the ideas, knowledge and experience of external resources to cooperate with internal personnel to achieve joint development and innovation (Demil B et al, 2012; V Anzola-Román P et al, 2019). This innovation model breaks the traditional knowledge boundary problem within the organization, and realizes the integration of external ideas and technologies with internal ideas and technologies by introducing external resources (A. Chatterji, and K. Fabrizio, 2014). This process faces several problems: first, who to find for joint innovation; second, how to effectively explore the knowledge of external resources; third, how to import the knowledge and technology explored from external sources into the development system; after all, enterprises generally have limited personnel in contact with external information, only some of them accept external information (Zhou Xiang et al, 2018), while others do not. At this time, there is inertia in product development, maintaining the original system for product development (Blazevic and Lievens, 2008), how to eliminate this external inertia? These are worthy of study in the academic circles. This paper introduces the thinking of lead users, uses lead users to gain insight into external needs and technologies (He Youlong, 2021), and uses collaborative innovation method to introduce external information into the internal development system to achieve joint innovation (Von Hippel E, 2005). This paper is a comprehensive application of two main methods: collaborative innovation method and lead user method, and at the same time, in order to gain better insight into user information and better integrate concepts. It also introduces the user research method and concept screening method, and integrates multiple academic methodologies to carry out collaborative innovation.

1.2.2 Lead User Theory

The Lead User method is proposed by Eric von Hippel, an American professor, who advocates using the advanced knowledge and experience of users to innovate products or services. (Eric von Hippel,2009). Also lead users define as the one who own rich knowledge and experience regarding product use, user needs, and demand trends constitute one of the most important sources for product innovation (A. Chatterji, and K. Fabrizio,2014). Lead users are found to come up with commercially attractive user innovations and have been shown to be a highly promising source of innovation for new product development tasks. According to lead-user theory, these users are defined as being ahead of an important market trend and experiencing high benefits from innovating （Schreier M et al,2008. Allowing leader users to participate in the product development process, interact with product developers, and gain insight into the ideas of leading users can greatly improve the innovation of products (Franke et al. 2006). lead user innovation is the creation of the Open Innovation theory, which has is actively discovered and used by firms, what awoke the companies and show them how they can benefit from Lead User Innovation. (Chen Rongqiu.2005)

The leading user method is a general term for a series of management activities, such as attaching importance to lead user, cultivating lead user, mining lead user, collecting lead user' ideas and realizing leading users' creativity Ye et al,2023. Lead users are also known as enthusiasts in China (Wang Xiaobing,2017). Many enterprises put forward the business philosophy of "born for enthusiasts", which is a management strategy of the leading user method. In order to better tap leading users and gain insight into the ideas of leading users, various enterprises have put forward different management strategies for leading users' strategies. The more common methods of insight into leading users include workshop innovation of "drawing users" and interview insight innovation of "going to users". With the rise of the Internet, online data analysis innovation for lead user has also become a common management strategy for enterprise innovation. There are several main characteristics of leading users: 1) Leading users have great interest in their fields of concern, and will continue to learn relevant knowledge; 2) Leading users will constantly try to use new products and seek

new experiences; 3) Leading users are willing to share their experiences with others (C. Luthje,2004 and Morrison, P. D., J. H. Roberts et al.2004).

1.2.3 The theory of decision making

Decision-making theory is a theory developed by the economist (Herbert Simon, 2000). Decision-making theory consists of decision concept, principle and theory. According to Simon's theory, decision theory takes the rationality pursuit of decision-makers as the main research direction. Decision makers pursue finite rational solutions, and they pursue satisfactory solutions rather than optimal solutions (Herbert Simon et al.,2013). Decision-making theory mainly states that the decision-making process is divided into four stages, the first stage is the stage of intelligence activities. Its main purpose is to find the data and information needed to make decisions, and to understand the problems that need to be made. The second stage is the design activity stage, the main purpose is to develop alternative plans; The third stage is the decision-making activity stage, the main purpose is to evaluate the various schemes based on the past experience (Schultz C et al, 2013), the current situation and the future forecast, and select the best scheme from the alternatives; The fourth stage is the review stage, which is the process of information feedback and revision in the decision-making process. Generally, only the first three stages are used in the product concept design process. When the product concept is determined, it enters the development stage. The development process is the business of other departments, and the secondary concept modification is rarely carried out. The application environment of decision theory in the concept screening stage is as follows: 1) The product completes the summary of the initial concept. 2) There are multiple departments to negotiate and confirm the final selection concept. 4) The planning department takes the lead and finalizes the concept for product adoption (PeterkovaJ et al.,2018).

1.2.4 Concept of User interview method

The interview method is a way to obtain information by talking with the survey object directly and purposefully (Ren Zhixiang et al.,2010). Household-entry interview is an investigation method in which interviewers collect information through interviews at the interviewees' homes or units in accordance with the procedures and requirements stipulated in the survey program (Ren Zhixiang, 2010). The primary purpose of user research is to help enterprises define the target user group of the product and clarify and refine the product concept (TAN Run-hua,2022). Through the research of the user's task operation characteristics, perceptual characteristics, cognitive psychological characteristics, the actual needs of users become the guidance of product design, so that the product is more in line with the user's habits, experience and expectations. Its approach draws on the various methods of the humanities and social sciences, with the aim of bringing the best experience to users, including designers and product users. Research on user research methods can help researchers and designers quickly find the needed methods, so that enterprises can determine the target user group faster and more effectively, and improve the efficiency of user research (Steve Portigal et al., 2015).

In user research interviews, the field work method is often used in conceptual interviews. The field work method is an interview method developed by Malinowski and Bronislaw Kaspar (1884-1942), which is mainly used in ethnological research and is used in product user research. The work features of fieldwork include: 1. It goes deep into the life of the interviewee. Fieldwork is a sociological interview method. Sociological interview is characterized by penetrating into the life of the interviewee and living together with the interviewee. 2. The field work method will understand the interviewee's social relations and explore the interviewee's behavioral characteristics from the social relations. This process requires understanding the interviewee's social relations, family member relations and lifestyle, so the interview process needs to ask this information in advance, which usually takes more than 30 minutes. 3. The fieldwork method focuses on integrating into the life of the other party,

so the interview process starts with talking about everyday situations, which is a kind of interview mode to avoid conflicts. When conflicts occur, the interviewer should change the topic to avoid further strengthening the conflicts; 4. Fieldwork requires high skills of interviewers. Interviewers should have the ability of empathy and be able to quickly integrate into the life situation of interviewees; 5, For the interview of the product, field work method should also conduct scene simulation to understand the needs of users when using the product in detail, why to use the product, how to use the product. (Qiao Mingming et al., 2021)

In order to better conduct in-home interviews with products, scholars have studied situational simulation interview techniques, conducted interviews with products in the context of their use, and conducted inquiries according to the steps of products, which facilitates communication between consumers and interviewers, helps interviewers and consumers to have empathy, and helps consumers to put forward their own ideas as much as possible in the scenario. In order to enter the home interview personnel more effective mining concepts. (Liao R et al.,2017, Gu Kaifeng.,2013, Yan J.,2002)

Domestic scholars put forward the semi-structured interview method, which features that the content and direction of the interview are fixed, and the interviewer conducts the interview according to the structural framework. This interview method reduces the difficulty of the interview and improves the speed of the interview. (Andrea Fontana.2007, Yin Yi et al.2008)

1.3 Model building and research hypotheses

This research examines six factors: Customer Competence of Lead User, User insight, Conceptual Collaboration innovation competence, Conceptual Decision-making competence, Innovative Leadership, User collaborative innovation, Based on the literature, the model framework between variables is studied, and hypothesis testing is performed between input variables and output response.

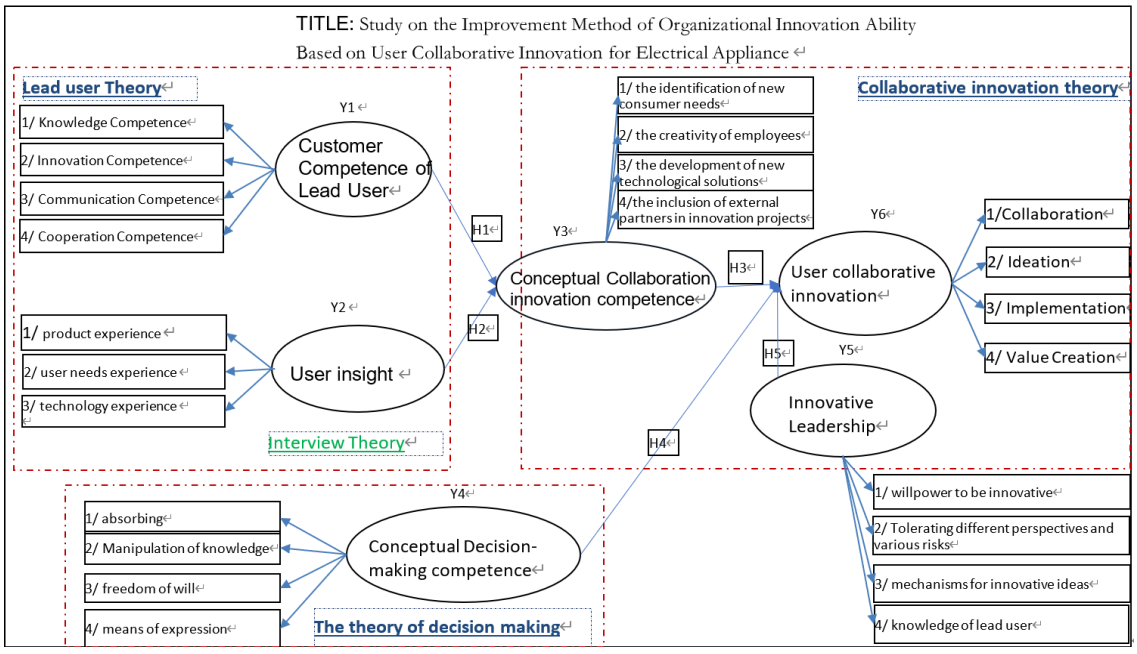

Figure 1: Conceptual Framework

The following hypotheses are proposed according to the model:

H1: Customer Competence of Lead User affects Conceptual Collaboration innovation competence.

H2: User insight affects Conceptual Collaboration innovation competence.

H3: Conceptual Collaboration innovation competence affects User Collaborative Innovation.

H4: Conceptual Decision-making competence affects User Collaborative Innovation.

H5: Innovative Leadership affects User Collaborative Innovation.

Research design

Define Variables

User Collaborative Innovation: It is the use of lead users' innovative ideas, knowledge, and technology combined with the development process of the enterprise, so that the internal resources of the enterprise and the external resources of the enterprise are combined to form cooperative innovation.

Customer Competence of Lead User: Leading users can gain insight into the future consumption trends of general users, leading users have enough knowledge to solve pain points, and leading users are willing to actively share their knowledge and skills. It has a high resolution of the products of interest and a wealth of product-related knowledge.

User Insight: Summary of interviewing skills and conceptual insight of the interviewer on the leading users. This insight focuses on the interviewing ability of the interviewer during the one-to-one interview, which is closely related to the interviewer's knowledge background, empathy ability, and structural composition of the interviewer.

Conceptual collaboration innovation competence: It is the competence of the planning department or user research department to investigate innovative concepts. Large consumer electronics companies include the unit responsible for user research, which will conduct concept interviews in the early stage of new product development. After discussion by several departments, the pain points and needs obtained by users are transformed into internal development language, which is called concept, and the concept set is finally formed. The concept set is the basis for later product development. The innovation of the concept set, the satisfaction degree of users' needs, and the acceptance degree of leading users' ideas are all the keys to the success of collaborative innovation.

Conceptual Decision-making Competence: it is the communication efficiency of multiple departments to jointly determine the final concept of the product through negotiation. This ability is reflected in the ability to retain innovative concepts, the user attraction ability of the concept combination of the decision, and the premium ability of the product. This concept decision-making process is the process of selecting multiple concepts and finally clarifying the product concept combination. The selection process needs to consider the innovation of the concept, the reliability of the concept, the cost of the concept, the premium of the concept, and the attractiveness of the concept. Therefore, it is necessary for team members to participate in the discussion to have certain technical capabilities, innovative willing, cost recognition, and understanding of lead users' needs, so as to ensure that external resources can be integrated into the enterprise and maximize the use of internal resources.

Innovative Leadership: Innovative Leadership is the leader's influence in the process of conceptual decision-making. If the leader's thought is conservative and competitive, the more he interferes in conceptual decision-making, the worse the innovation of the concept. On the contrary, if the leader is an enthusiast, the leader's intervention will greatly affect the product innovation. At the same time, if leaders actively participate in the interview process and have insight into the ideas of some leading users, the decision-making process may be more innovative. Finally, whether leaders are inclusive to different ideas has a decisive impact on innovation. If leaders are not inclusive, the role of user insight in the early door-to-door

research may become negligible, because no matter what good concepts are found, they will eventually be screened out in the process of concept selecting communication. It is the responsibility of innovative leaders to construct innovative management mechanism.

1.4 Scope of Variables

The variables in the research are:

(1) Dependent variable: User collaborative innovation

(2) Independent variable: Customer Competence of Lead User, User insight, Conceptual Decision-making competence, Innovative Leadership

(3) Mediating variables: Conceptual Collaboration innovation competence

1.5 Scope of population

When determining the questionnaire questions for each factor, the population is the company's new product development managers. For Quantitative research for SEM modeling, the population is new product project managers and project planners.

The subject of the interview is the new product development of small household appliances, small appliances are small appliances related to cooking in south China.

1.6 The significance of the research

The significance of study includes academic significance and practice significance, which showed below:

Academic significance:

Combining lead user method and collaborative innovation method into user collaborative innovation method(new)

New integrated innovation method in the academic area.

Certain guiding significance for management innovation

Gives a set of system model to improve the product innovation ability of enterprises

Practice significance:

Guide new product development and design for innovation

understand which key variables affect the collaborative innovation of users

Enterprise managers can learn from the research results of this paper to control the key management nodes

Improve the innovation ability of enterprises and improve the competitiveness of enterprises.

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