

## **A Study on the Survival of Small and Micro Enterprises in Open Technology Innovation from the Perspective of Information Ecology**

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**Abstract** — This paper introduces the theories of open technology innovation and information ecology, from the perspective of information ecology. It combines a series of problems which small and micro enterprises face in the process of open technology innovation activities. It explore how to realize dynamic balance of the small and micro enterprises open technology innovation information ecosystem, in order to establish and improve small and micro enterprises information service platform. This would increase the effectiveness of information services, and promotes small and micro enterprises technology innovation to achieve sustainable healthy development. Through the theory of information ecology, this paper puts forward countermeasures on the small and micro enterprises internal and external problems of open technology innovation for enterprises to reference.

**Keywords** - *Open Technology Innovation; Small and Micro Enterprises; Information Ecology; Ecological Balance*

### I. INTRODUCTION

Under the background of economic globalization and innovative internationalization today, open innovation as the mainstream of enterprise innovation mode has become a trend. The purpose of implementing open innovation activities and results is to breakthrough the limitation of enterprise boundary, and to integrate internal and external innovation resources. Because small and micro enterprises are becoming more and more prominent in the status of the entire national economy development and the innovation ability in our country, carrying out technical innovation activities has become one of inevitable choices. What's more, with the competition becoming more fierce and the risk and cost of innovation increasing, and considering the present situation of the innovation resources and ability deficiency of the small and micro enterprises in our country, open innovation has become the inevitable demand of small and micro enterprises in China. It helps to enhance the strength of innovation of small and micro enterprises and speed up the pace of innovation, and to participate in international competition. This paper is based on the view of information ecology, to explore how to realize dynamic balance of information ecosystem of the small micro enterprise technology innovation service platform, and to promote small and micro enterprises technology innovation and sustainable healthy development.

### II. LITERATURE REVIEW

#### A. *The Concept of Open Innovation*

On the basis of paying full attention on the internal research and development, through the permeable boundary enterprises recombine production factors, implementing new technology research and development at the same time in the enterprises internal and external, which is called open technological innovation.

#### 1) *The Object of Open Technology Innovation and its Characteristics*

Technological innovation is a dynamic process of economic and technological activities. According to the different object of enterprise technology innovation, it can be divided into technological innovation, product innovation and management & system innovation. Open innovation mode differs from the traditional closed innovation model, as shown in Table 1. In this mode, enterprises want to improve the technical ability, they must use both internal and external resources, and effectively consolidate them to develop and improve the technology. However, they mainly rely on internal force to develop technology, product and process, then realize commercialization. Besides, they can possess external ideas by buying them.

TABLE 1. THE BASIC CHARACTERISTICS OF THE CLOSED INNOVATION AND OPEN INNOVATION

Factor Comparison	Innovation Model	
	Closed Innovation	Open Innovation
Human Resource	Hire the best talent in this field to work for us. Every researcher should become an outstanding inventor.	We must cooperate with all the outstanding talents inside and outside the enterprise. Every researcher should be a technical genius with a business mind.
Sources of Innovation	Internal research and development	Internal R &D and external innovation resources
Technological Environment	Shortage knowledge	Knowledgeable
Organization Method	Taking vertical integration strategy and strict control	Taking vertical disintegration and dynamic cooperation
Organization Boundary	Complete closure	Boundary permeability
The Relationship with Other Companies	Competition	Division of responsibilities
Operation Philosophy	The first enterprise to turn technology into a product will be a winner	Establishing the best business model may be better than the first to enter the market

*B. The Theory of Information Ecology*

*1) The Definition of Information Ecology and the Formation of the Information Ecological Environment*

In 1997, the American scholar Thomas h. Davenport and Laurence Prusak co-authored the information ecology: mastering the information and knowledge environment, putting forward the concept of micro level of information ecosystem, they point out that information ecosystem refers to taking the overall point of view to analyse some complicated problems that impact on organization internal information-utilization ways, and use the concept of system to analyse the interaction problem of many different phenomena. Information ecological environment refers to the macro-environment which information can be transferred among different subjects, it consists of information producers, information consumers, Information trimmers and information environment.

*2) The Information Ecology Balance Advanced*

In nature, forests, lakes and other ecosystems consist of biotic component and abiotic component. Because mutual connection and restriction different parts form a unity. A relatively stable equilibrium among them is achieved by the interaction each other, we call it the ecological balance. Chinese scholars Lou Cequn and Zhao Guiqin on the ecological balance point of view, putting forward the viewpoint that the information ecology balance, they define information ecological equilibrium as a relatively stable state that components operate well within information ecosystem. The state of equilibrium needs self-regulatory mechanism to maintain balance in the internal of ecological system.

III. THE INFORMATION ECOLOGY ANALYSIS OF SMALL AND MICRO ENTERPRISES OPEN TECHNOLOGY INNOVATION

*A. Implemented Conditions*

With the advent of the era of big data, enterprise information organization modes are in the constantly changing, information-processing means are increasing, and every organization has its own information system. Because the information system separate from each other independently, not sharing, there are serious "information island" phenomenon. In the mode of small and micro enterprises open technology innovation, this kind of phenomenon not only exists in every link of enterprise internal, but also exists between companies. Therefore, under the support of advanced technology, they must integrate all aspects of the information, creating positive information environment that can inspire people, small and micro enterprises can successfully carry out open technology innovation activities in the information age.

*B. Ecological System Internal and External Environmental Analysis*

As with nature's ecological environment, the information ecological environment of small and micro enterprises open technology innovation is made up of their own special information-ecology factors. From the enterprise internal and external information environment, and according to the degree of correlation with the enterprise, information-ecology factors can be divided into macro-correlation factors and micro-correlation factors. Macro-correlation factors of small and micro enterprises have policy, economy, technology, society, finance and tax; Micro-correlation factors mainly include the innovation consciousness, innovation resources, enterprise culture and organization structure.(as shown in Figure 1)

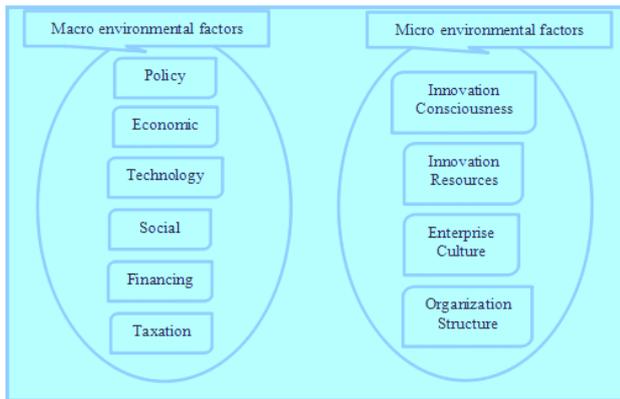


Figure 1. The Analysis of Macro and Micro Factors in the Information Ecological Environment of Small and Micro Enterprises Implementing Open Technology Innovation

### 1) The External Environment Analysis

#### Policy Environmental Analysis

The 18th Congress of China's Communist Party clear: improving our country enterprises independent innovation ability, speeding up the transformation of the mode of economy, and achieving faster and better development of national economy. It is not enough that improving the independence of innovation ability only by state-owned enterprises, large enterprises and scientific research institutions. Thus, some relevant policies that make for the development of small and micro enterprises with science and technology innovation are also developed. It plays an important role for the rapid and sound development of small enterprises in our country to some degree, but there still exist some problems, such as poor-directed policy support system, scattered distribution.

#### Economic Environment Analysis

The influence of the financial crisis in 2008 manifest that the economic development of our country is strongly influenced by the world economic environment fluctuation, hence the survival environment of small and micro enterprises has a direct influence on its development. In addition, the prices of raw materials and other factors of production keep rising, and the labour costs are going up. For small and micro enterprises with small production scale, it undoubtedly form a huge threat to the survival and development of them, let alone technology innovation.

#### Technology Environment Analysis

First, comprehensive economic strength of small and micro enterprises is weak. Because of its high operating

costs and short life cycle, these factors hinder the innovation of small and micro enterprises; Second, the fund investment of small and micro enterprise in science and technology is insufficient; And again, the science and technology service system of small and micro enterprises is not perfect; Final, a shortage of scientific and technological personnel is serious. All of these become important obstacle factors affecting small and micro enterprises technology innovation.

#### Social Environment Analysis

Under the background of the knowledge economy, information has been viewed as an important strategic asset in the eyes of most enterprises. In order to obtain and maintain own competitive advantage, some small and micro enterprises called "vulnerable groups" are often not willing to share information and knowledge mastered by them with other enterprises. Because of the distrust existing in the enterprises, the collaboration among enterprises is very little, seriously affecting the process of open technology innovation of small and micro enterprises.

#### Financing Environment Analysis

Our country has published financial policies and measures supporting the development of the small and micro enterprises since 2011, which reduces the pressure of some small and micro enterprises to some extent, and makes for carrying out technology innovation activities. In a sense, our small and micro enterprises need more policy-oriented financial support. Because the financing procedures is too complicated, the financing difficult problems of small and micro enterprises are not solved in the present stage.

#### Tax Environment Analysis

The business activities of small and micro enterprises should pay 17% of the value added tax and 20% of the income tax, thus, the problem of too much pay cost project is increasingly outstanding, and huge tax expenditure has increased the burden of small and micro enterprises, which slow down the pace of development for them.

### 2) The Internal Environment Analysis

#### Innovation Consciousness Analysis

At present, small and micro enterprises mainly depend on introducing innovative technology to improve their technical level, and neglect their own development and invention of innovative technology, such as insufficient innovation consciousness and unreasonable innovation concept. Owing to attaching more importance to the

introduction of innovation, they ignore the digestion and absorption of innovation technology, finally they can't grasp it, which weaken the innovation strength of small and micro enterprises, and hinder the improvement of the level of its innovation.

#### Innovation Resources Analysis

Small and micro enterprises in our country are confronted with numerous difficulties during the process of the open technology innovation, such as scarce innovation resources and weak basic research and development ability. With the continuous development of society, the information resource as one of the three major resources is very important to the produce and development of the enterprise, and it has become an important strategic resource for national economic and social development. We should realize that the development and utilization of information is the core content of the information system, but the ability of obtaining innovation information is limited for small and micro enterprises, it is not easy to launch open innovation activities.

#### Enterprise Culture Analysis

Enterprise culture can make the enterprise employees understand its social significance of existence, and make them consciously working diligently for the enterprise and for realizing themselves life value. Establishing an atmosphere of technology innovation culture in the small and micro enterprise internal helps to develop open technology innovation activities smoothly.

#### Organizational Structure Analysis

Small and micro enterprises carrying out open technology innovation should establish a organizational structure making for the creation and communication of knowledge information. A sound organizational structure can guarantee sufficient liquidity of knowledge, and is propitious for information and knowledge sharing among enterprises. In addition, forming an independent innovation atmosphere in the internal of small and micro enterprises, and letting all the staff involved in the innovation activities are also conducive to establish good shared networks within the enterprises. Sad to say, most enterprises in our country actually take linear system, matrix, and other forms of centralized management, but these organizational mechanism does not adapt to the operation of small and micro enterprises open technology innovation mode.

#### IV. THE INFORMATION ECOLOGY PROBLEMS OF IMPLEMENTING OPEN TECHNOLOGY INNOVATION IN SMALL AND MICRO ENTERPRISES

The ecological chain is the most basic core of ecological environment construction. Information ecological chain is a chain dependency relation which refers to information flow occurring among the different types of information man in the information ecosystem. Achieving the ecological balance of small and micro enterprises open technology innovation refers that various structural elements, scale, input and output quantity of small and micro enterprises information ecosystem are in a state of stable and smooth, and so it was a state of equilibrium 'Information-Information Man-Information Environment'. In this article, information ecological chain structure of the small and micro enterprise open technology innovation is drawn up using the principle of information ecological chain, as shown in Figure 2.

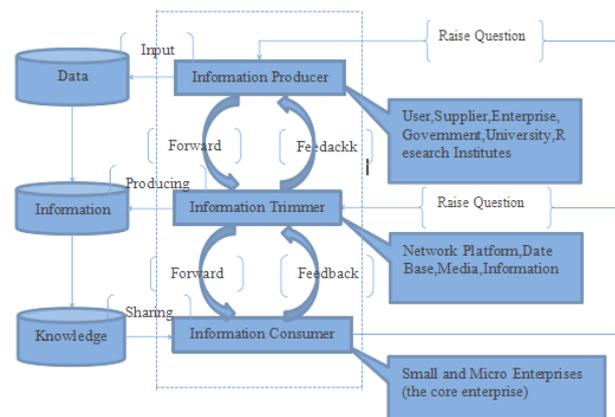


Figure 2. The Information Eco-chain of Small and Micro Enterprises Open Technology Innovation

People live in a specific environment which have influence on people's activities. In the process of developing open technology innovation for small and micro enterprises, organizations and individuals will be affected by the information ecological environment more or less. On promoting the small and micro enterprises knowledge production, information application and information organization transformation, the information man in the small and micro enterprise as a key role becomes so important. To achieve small and micro enterprises information-based and knowledge management, we must do the following:

First, collecting a lot of information and accumulating a wealth of information resources;

Second, arousing the enthusiasm of the information man activity;

Third, creating good information ecological environment conducive to the development of information man;

Fourth, achieving rapid delivering, sharing, application between information and knowledge.

In the information eco-chain of small and micro enterprises open technology innovation, the effect of each link are inequitable. Any part going wrong can create unbalance of small and micro enterprises information ecosystem, causing the enterprise information flow efficiency declining and reducing the social economic benefits. In the process of the implementation of open technology innovation, we have analysed the internal and external environmental factors small and micro enterprises faced and the information ecosystem in which they were, the unbalance of information ecological chain especially lies in the "lack of information", "information divided" and "information island" three aspects. Further analysis following:

The policy supporting the small and micro enterprise open technology innovation is relatively scarce. On the one hand, social attention to small and micro enterprises are not enough; On the other hand, the group of small and micro enterprises lack of understanding of relevant policy information.

Some research about small and micro enterprise open technology innovation often break away from the macro-economic environment, thus they are unable to obtain complete information and make the research of itself value greatly reduced.

The lack of cooperation with other enterprises for small and micro enterprises in the process of implementation of open technology innovation, and they will not be able to timely access to other enterprise information about technology innovation. Failed to realize knowledge sharing undoubtedly cause the cost increasing and the pace of development slowing.

The financing difficult problem of small and micro enterprises is increasingly prominent. On the one hand, the information small and micro enterprise providing is so incomplete that the bank sets a higher threshold for them; On the other hand, the credit of small and micro enterprises is difficult to measure, therefore, the money supply is not timely, then impeding the development of open innovation.

Owing to the existence of the traditional closed innovation model, it's difficult to realize innovation

resources sharing among enterprises, then, a lot of information for part of the enterprise is vacant. Hence, small and micro enterprises have trouble optimizing the information resource configuration and effective exploiting and utilizing them, let alone innovation together.

Based on the above considerations, we put the small and micro enterprise as a group into innovation environment which is a large information space to analyse. For some innovation resources (include human resources, financial resources, material resources and information) are fail to form effective and reasonable distribution, combination and use among different behaviour subjects such as enterprises, government, universities, research institutions and intermediaries. That is to say, innovation resources allocation efficiency is not high. In view of the present internal and external problems of small and micro enterprises open technology innovation, we have put forward some measures for reference.

## V. THE BUILDING OF THE DYNAMIC BALANCE MECHANISM AND SERVICE PLATFORM OF IMPLEMENTING OPEN TECHNOLOGY INNOVATION

According to analysis, we have found that innovation obstacles small and micro enterprises faced in the process of technology innovation make it difficult to carry out open technology innovation activities smoothly. Small and micro enterprises must be able to search, identify and confirm rich intellectual resources from the external in the complicated knowledge network, using more external innovation resources, integrating internal and external technology reasonably, and to solve a series of management problems.

### A. *The Dynamic Balance Mechanism of Small and Micro Enterprises Open Technology Innovation*

In the mode of open technology innovation, small and micro enterprises as a large system composed of a basic social unit is so intertwined with the other parts. In the fierce competitive environment, to set up a dynamic balance mechanism about the small and micro enterprise open technology innovation, small and micro enterprises must innovate in the interaction with other organizations (suppliers, customers, competitors, universities, research institutions, investment institutions, government agencies, etc), then bring economic benefits for small and micro enterprises and society. The internal resources include all employees and all related departments within the enterprise in the process of innovation, and the external innovation resources are various external stakeholders those who may

make contributions? to enterprise innovation, such as suppliers, customers, etc.(as shown in Figure 3)

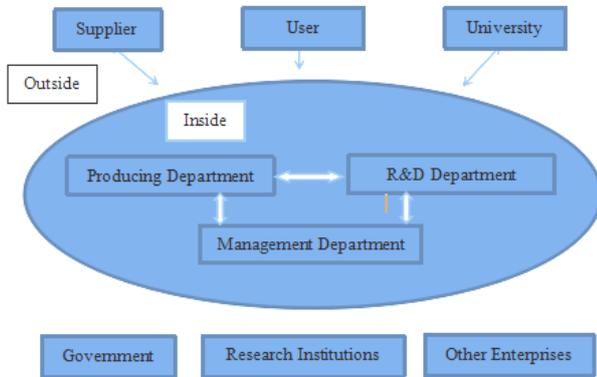


Figure 3. The Dynamic Balance Mechanism of Small and Micro enterprises open technology innovation

*1) Cooperate with Supplier for Sharing Knowledge*

Small and micro enterprises can enhance sharing information with supplies about cost and technology to shorten the innovation cycle and improve efficiency. Therefore, small and micro enterprises can get help and support from external suppliers to reduce the burden of small and micro enterprises in the value chain, making for faster and better development in the core of open technology innovation.

*2) Cooperate with the User for Information about Innovation*

In the process of open technology innovation, it is an important way to guide users to participate in product innovation for effectively integrating the user resources. Through establishing such an interactive mechanism to form stable relationship between enterprises and users, they can speed up information transmission. As we all know, p&g "360-degree innovation" is around the customer experience for all-round innovation.

*3) Cooperate with Other Enterprises for Establishing the Innovation Strategic Alliance*

In order to correctly evaluate each stage of the development process, small and micro enterprises requires a lot of information. By means of establishing the innovation cooperation strategic alliance they can obtain some information of technology innovation. Because of the different levels of knowledge, it is conducive to learn respective advantages from each other and make progress together.

*4) To Strengthen the Cooperation with Universities, Scientific Research Institutions*

It is wise to cooperate with universities for carrying out open technology innovation. On the one hand, the

university is in the forefront of academic research, strengthening the contact and cooperation with universities can timely access to the latest news and theoretical results on the small and micro enterprises open technology innovation. On the other hand, universities are talent magnet, thus enterprises can share research results through cooperating with colleges and universities. Finally, some enterprises can create conditions to ensure sustainable enterprise talent input in the form of providing internships or scholarship for good universities.

*5) Improving the Financing Difficulties of Small and Micro Enterprises*

On the one hand, small and micro enterprises should form the interaction of credibility with upstream and downstream enterprises by developing the supply chain finance. Through the development of supply chain finance, some problems of asymmetric information are alleviated to a certain extent in small and micro enterprises credit. On the other hand, small and micro enterprises should actively promote technological finance innovates and apply for some transformation projects turning scientific and technological achievements into practical application, acquiring the relevant preferential policies or financial support, and to solve the plight of small and micro enterprise effectively. Regulating internet finance and placing it in the category of effective regulation are important missions government facing in the recent macro economic control.

*6) Enhancing the Government's Policy Support*

First, government should create a positive environment that is suitable for survival for small and micro enterprises. Next, they can launch a series of policies conducive to the development of small and micro enterprises, such as tax reduction and offering a variety of financing channels. Those require relevant departments to take measures.

*B. The Service Platform Construction of Small and Micro Enterprises Open Technology Innovation*

The fundamental way of small and micro enterprises lies in improving the national technology innovation system and setting up open technological innovation service platform. The national technology innovation system is a social system in which the government take a lead and give full play to the basic role of market resources allocation, all kinds of science and technology innovation subject closely linked and effective interaction. Nowadays, our country basically form the government, enterprises, research institutes and universities, technology innovation in the four corners of the innovation system of supporting service system. The system emphasizes the importance of them--the government's policy, the enterprise research and

development, education and training, as well as the industrial structure and so on. Based on the four points small and micro enterprises can establish service platform to realize information sharing through the network sharing center.(as shown in Figure 4)

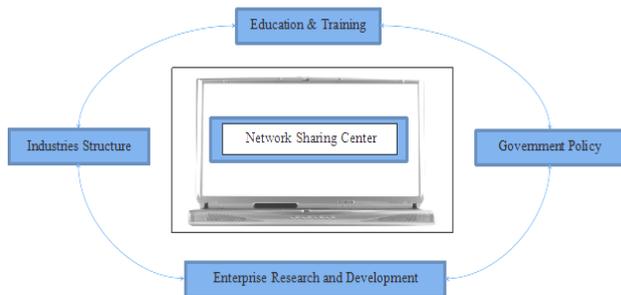


Figure 4. Small micro enterprise open technological innovation service platform

## VI. CONCLUSIONS AND EXPECTATIONS

As mentioned, there are a series of unfavorable factors and threat in the process of small and micro enterprises open technology innovation, of course there are some favorable conditions and opportunities. The interactions between them directly affect the development of the enterprise technological innovation, and the complexity and uncertainty of these is not sufficient to illustrate in this article, but we still can develop an integrative view of its mechanism through learning and understanding in the future. We also believe that, along with the various policy gradually improving, the macro environment of small and micro enterprises development become more and more good, so small and micro enterprises open technology innovation mode will have healthy development of the new land.

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