

## A Review Concerned to Research on System Paradigm of Innovation

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**Abstract:** In the research of innovation, the technique innovation, enterprise innovation, national innovation, and regional innovation, they all can be considered as a system that is made up of a lot of elements and correlation, namely innovation system. Up to the present of the development of innovation theory, the integration, network and systematization have been proved to be a trend of development of innovation theory. The article mainly discusses theory of evolution and the specific characteristics of research on the System Paradigm of innovation.

**Key words:** innovation system; System Paradigm; synergistic evolution

As the thought of System has a long history, which is known to all, it's constructed by theoretical biologist CL.Von.Bertalanffy, an Austrian-Canadian. The word System comes from ancient Greek, is the meaning of a whole is made up of parts. The system is usually defined as an organic whole which has a certain function and is a made up of a number of elements, those elements link with a certain structure. In this definition, which include four concepts system, elements, structure and function, indicates the aspects of relationships among elements and factors, elements and systems, systems and environment.

Ideas about innovation systems, the earliest can date back to Marshall's industrial district theory. As early as 1890, before Schumpeter, Marshall pointed out that there are strong atmosphere of innovation in a small business gathering area, where new technology, new ideas can be quickly accepted and spread. In other words, what Industrial Park described by Marshall formed an innovative environment, all SMEs through this network to compete effectively with the cooperation and communication, to promote the formation and dissemination of the new technologies and new ideas.

### 1. THE EVOLUTION OF THEORY OF INNOVATIVE "SYSTEMS PARADIGM"

Enterprise Innovation Theory reveals the innovative behavior of enterprises from a micro-system perspective. Later Neo-Schumpeterian school of researchers who basically followed the Schumpeterian tradition, focus on the studies such as the process of technological innovation, the resulting basement of

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technology and economic of technological innovation, technology trajectories and technological paradigms, proliferation of technological innovation and so on. The perspective itself of these research places great emphasis on micro-systems analysis. Although the enterprise innovation system is not used as a special concept to define in the study of innovation theory, so far, micro-level theory of innovation, always try to consider the enterprise as a whole organism to study the basic law of its technical innovation. Therefore, we called that phase the enterprise innovation system.

Putting forward of the National innovation system theory is the real starting point of an innovative system, the main representative are Freeman, Lundvall, Nelson, Edquist and so on. Based on the study of the Japanese innovation system, Freeman firstly defined the national innovation system as " the network of institutions of the public and private sector, through their activities and interactions, we can see the stimulation, introduction, change and diffusion of new technology." The national innovation system consider geographical and administrative boundaries as the boundaries of innovation systems, concerning the national economy and policies have an effect on technology innovation and diffusion, while studies the promoting to the study, interactive innovative under the condition that in the same country and the proximity of the Cultural and linguistic.

With the expansion of the system paradigm, there are scholars who questioned the study of the national innovation system, mainly in two aspects: Firstly, within the same country, there may exist different cultures, policies and systems in different regions, adopted by different industries, the knowledge and technology has its own characteristics, so the innovative activities in different regions and industries are also different, the theory of national innovation system is very difficult to generalize; Secondly, on the impact of economic globalization, how much effects do the state can have on the innovation system? With the globalization and the disappearance of international borders, Ohmae believes that "national state" increasingly given way to "regional state" from an economic sense, and region has become a real sense of economical interests of the main body, while the key business of multinational companies are also focused on contacts in the regional context. Thus, based on the criticism and succession of the national innovation system of the theory, scholars have increased the regional innovation system, considering that the regional innovation system is composed of the geographical division of labor between the production and related enterprises, research institutes and higher education institutions constitute regional organization systems that support and create innovation. Proposal of the regional innovation system, not only is equally concerned about affection of the culture and system in the innovation process, more specific studies the relations of different participants in the innovation process, especially suppliers and users, as well as the interaction between enterprises and research institutions.

Some scholars questioned the national innovation system and regional innovation system, considered that the boundaries of innovation systems are not subject to fixed geographical borders, and recommended the use of industrial innovation systems concept. Industrial innovation system refers to the network posed by the development, production and sales of products in specific sectors between participants through the market and non-market linkages. Malerba maintained that the advantages of industrial innovation system depended on its ability to better understand the boundaries of industrial sectors, participants and their interaction, learning, innovation and production processes, changes in industry and the enterprise's, state's performance in different industries. Different from the national innovation system and regional innovation systems, industrial innovation system considers that the link between enterprises and organizations mainly come from the interdependence of technology. Therefore, the dynamic coordination of the technological development and technology flows within the industry has become more important. Contribution to industrial innovation system lies on its attention to the different technology and industrial innovation process with their respective characteristics and that in order to better understand the process of innovation we need to better understand the relationship between science and technology, to better understand the nature of technology. At the same time, industrial innovation system also suggested that, although there are different in competition, interaction and organization of the state in different industries, the extension of its geographical boundaries is still dynamic, which may be in one area, or may span multiple borders.

The theory of cluster innovation system is the system of regional innovation and industrial innovation at the intersection of two theoretical developments. Cluster innovation system refers to,

within a narrow geographic, the innovation networks and institutions, which are made up of cluster-based and regulatory arrangements, by means of formal and informal, promote the use of knowledge in clusters to the creation, storage, transfer and application of a variety of activities and mutual relations. In the cluster innovation system elements, the most critical element is the collection of related enterprises of industrial clusters, as well as the network formed by them. Followed by clustering technology infrastructure, including hardware infrastructure and software infrastructure, One software infrastructure, including research and development institutes, laboratories and universities, human resource development and training institutions, and provision of related services to financial institutions, industry associations, technical service organizations, and so on. The third element is the cluster environmental factors, including society, culture, government, external resources and institutional regulation, etc. These factors constitute the three levels of network of the cluster innovative system: core network, support network and the perimeter network.

Based on the above review of innovation systems theory, we can know that, after Schumpeter, the scholars paid attention to the innovation system from different angles: some scholars attached importance to the innovation network under a certain degree of system and culture, made the geographical boundaries as the boundaries of innovation systems, created the theory of national innovation systems and regional innovation systems; while some others focus the study on innovation collaborative relationship formed by technology transfer, links between supply and demand, proposed the concept of industrial innovation systems; After the two types of theory developed to cluster innovation, the system has been integrated effectively; In addition, there are some scholars began to pay attention to build a global innovation system, up to now, we can sort out the evolution relationship of innovation system studies, as shown in Figure 1.

## **2. THE CHARACTERISTICS OF RESEARCH ON "SYSTEM PARADIGM"**

In innovation research, strictly speaking, the previous method thought about the interaction between different innovative behavior on innovation institutions, but this interaction was very simplistic understanding. Research on "system paradigm" attaches important to all parts in innovation system those affect innovation, research on "system paradigm" is provided with nether some characters.

### **2.1 The imbalance of system development**

An innovative system of any physical object itself, there is difference coordination between balance and imbalance, are experiencing the cycle of movement and development process from the balance to the imbalance, even to a new balance. For the whole innovation system presents the dialectical relationship of interaction and mutual transformation between balance and imbalance of the system. From the point of view of any innovation system's own motion, there exist the various elements of differences within any system, and among the various elements there is always a certain proportion and relationships. When proportion relations of various elements of the system come to and maintain in a certain value, the performance between the various elements are the relationship of co-ordination, harmony, consistence or balance, and so on, as the system state in which the system can be called a state of balance. On the contrary, when the system showed lack of coordination, inconsistent or imbalance between the various elements, then the system state of development in which the system can be called the imbalance state. In the movement of system itself, there is neither a single balance from beginning to end, nor is single imbalance state from beginning to end.

The development of innovation system is a process of spiral, wave-like advancement, and in this process, the system is always from local breakthrough and then to the change of the whole, on the basis of the whole balance the system achieved new breakthroughs, the so on ad infinitum.

## **2.2 Non-linear of the systems development**

There are common links between the innovation systems, which links, exactly, present the continuous exchange of the matter, energy and information between the innovation systems, and such a conversion may be direct and linear, also may be indirect and non-linear; linear and nonlinear are two relative concepts, linear is a simple sum of the whole as a part, treat future development as a natural extension of recent trends, think that one reason for the inevitable to decide a result and that there is a straight line of causal chain between the systems. Non-linear is that there exist complex non-linear relationships between the various elements of the system, and a whole structure has complexity, as a whole is no longer simply equal to its parts. In order to know the whole we should not only understand the elements, but also understand the relationship between the various elements, as the world's essence is non-linear, complex and changeable.

With the development of innovation system, there occurred a variety of complex problems in the process, which are more and more showing non-linear characteristics. And in Linear model, the model of knowledge flow is very simple; the scientific research is the starting point of innovation, and the increasing the investment of the scientific research will directly lead to downstream innovation and new technologies increase along this line. However, in reality, there are a variety of innovative ideas that can come from research, development, market, and technology diffusion, at any stage. Technological changes do not occur in a perfect linear sequence, but occur in a variety of feedback cycle of the system. Thus, with the deepening of innovative research, the nonlinear characteristic of innovation system is gradually revealed out.

## **2.3 The synergistic of the system development**

Synergistic innovation is to have a synergistic effect (self-organizing feature) innovation, is that when innovation occurs to a subsystem or the constituent elements within the system, the other subsystems or constituent elements adjust spontaneously in accordance with its change of quantity and direction, thus to form a new system structure and function. The initial innovation is critical to the system, which not only affects the system in cooperation with the amount of change, but also determines the direction of the system synergistic evolution--orderly or disorderly. Synergistic innovation includes the innovation of knowledge, technology, organization (system).

## **2.4 The complexity of system structure**

In the vertical, the innovation system includes the macro-level national innovation system, in view of industrial innovation systems and micro-level enterprise innovation system. In the horizontal, the innovation system has knowledge innovation system, management innovation system, market innovation system and organizational innovation systems, etc. . No matter the macro or the micro, knowledge innovation or technological innovation, they are constituted by many factors. By the diversity of innovation of the main body and multilevel nature of the system structure, making the process of innovation is by no means a linear straight-line model, but a non-linear network model. Innovative activity can be done in various levels of individuals, corporations and countries. The various levels have many different combinations of their own, and different combinations can also produce different effects of innovation.

## **2.5 The uncertainty of system technology**

With the development of science and technology, the product has increased from a few components being transferred to hundreds, thousands, or even composed of 100 million components. The complexity of the product necessarily require for the improvement of technological level and the combination of multiple technologies, which increase the opportunities for innovation, as well as increase the complexity of innovation. On the other hand, whether individuals, companies or countries, faced with increasingly complex structure of products and technology demands, cannot solve all the problems in

reality with remaining of the original technology level and a fixed technology model, while there must be continuous technological innovation, dealing with complex requirements of innovation with a flexible and advanced technology.

## **2.6 The variability of market demand of system**

In the market economy conditions, market demand is the starting point of all innovation activities and the most fundamental driving force. Generation of any innovative idea and the introduction of innovative products, without the approval of consumer and the acceptance of market, cannot incarnate its value and carry out an objective evaluation. With the progress of science and technology and the improvement of people's living standards, the demand of consumer develops from low level to high-level, from simple stability to complexity change, making the diversity and level of social demand increasingly prominent, the contradiction between social production and demand of consumption become increasingly evident. Faced with this reality, any company cannot use the same kind of products to meet the needs of all consumers, but must constantly adjust product structure and service strategy to actively adapt to the complex and changeable market demands.

## **2.7 The instability of innovation environment of system**

Innovation environment refers to the collection of various elements, which exchange the material, energy and information with the entire innovation system. Including prop up system, education and training environment, basic research and applied research environments, institutional and policy environment and so on. Although they are not an intrinsic element of the innovation system, they played an important role from the outside of the innovation system. Whatever the level of innovation, its unique environment of nature and society is always changing with the passage of time and space, only the innovative system changes itself continuously to adjust the environment, can it make a appropriate choices.

# **3. CONCLUSIONS**

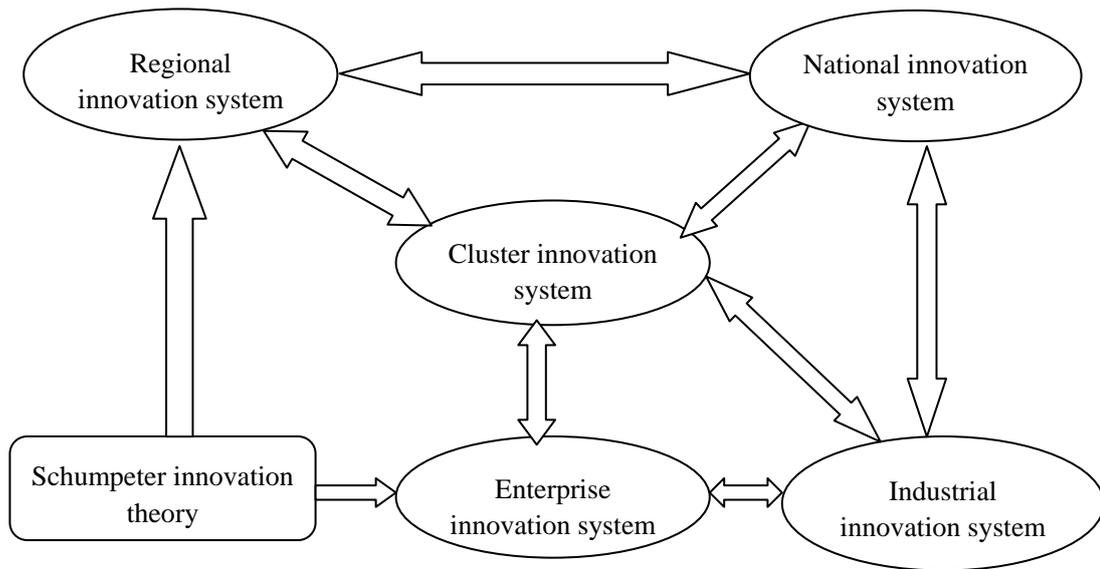
Innovative research began Schumpeter's work in the early 20th century, after passing through the post-war technology-driven model, demand-pull model, linking models, and chain rings-loop model, the beginning of late 80's in 20th century, new ideas of researching innovation from the system point of view is emerged. In short, no matter what innovation of national level, of regional level, or of industrial level, all can be regarded as a system made up of a variety of factors and their mutual relationships, namely innovation system. The "systems paradigm" of innovative research provides a new idea for our research of innovation, puts forward a valuable theoretical basis for us to build innovative systems.

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**FIGURE**



**Figure 1: The historical evolution relationship of innovation system theory**