

# Chapter 8

## Analysis on the Technological Innovation Mechanism of Regional Equipment Manufacturing Industry Cluster

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**Abstract** Technological innovation is the source of technological progress and competitive promotion for regional equipment manufacturing industry cluster. By analyzing the technological innovation mechanism with the technological innovation and industrial cluster theories together, this paper mines the key influencing factors of technological innovation of regional equipment manufacturing industry cluster. On this foundation, this paper provides scientific and theoretic basis not only for analyzing the technological innovation modes of regional equipment manufacturing industry cluster, but also for finding the ways to promote the technological innovation level and enhance the competitive advantage.

**Keywords** Industrial cluster · Influencing factors · Innovation mechanism · Regional equipment manufacturing industry · Technological innovation

### 8.1 Introduction

Equipment manufacturing industry is fundamental industry for regional economy, and its developing level reflects the comprehensive economic strength of a region at a certain extent. After a long period development, the equipment manufacturing industry in China has become a wide-range, considerable-scale and high-quality industry system. And it has been the pillar industry of economic development (Gao 2009). In recent years, the equipment manufacturing industry becomes more and more centralized and scale because of the advantages of industry cluster, and the equipment manufacturing industry cluster has become the focus of academic research. However, because the equipment manufacturing industry cluster in

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China is still at primary developing period, the study on industrial cluster is lack of the equipment manufacture industry part. There are many shortages of Chinese equipment manufacture industry in technological innovation area when compare with the international advanced level. These shortages caused that, the Chinese equipment manufacture industry at an inferior status in international competition. As we know, technological innovation has a lot of positive functions for equipment manufacturing industry cluster, such as changing the production technological foundation, reducing production costs, improving product quality and production efficiency. Beside that, technological innovation plays a core role of competitiveness of regional equipment manufacturing industry cluster.

At present, there are a lot of studies on technological innovation of the industrial cluster both domestic and foreign. Gregersen and Johnson (1997) use the 'learning economy' as an analytical framework to discuss how the process of European integration affects national systems of innovation. European integration is described as a process of institutional learning (Gregersen and Johnson 1997). Baptista and Swann (1998) analyzed whether firms located in strong industrial clusters or regions are more likely to innovate than firms outside these regions (Baptista and Swann 1998). Negassi (2004) points out that, R&D cooperation between firms is one of the many strategies by which this knowledge may be transmitted (Negassi 2004). Cheng and Zheng (2009) proposed a reverse double-boom evolutionary model to analyze the co-evolution of technological regimes and industrial clusters of developing counties, in which the first technological and industrial boom is led by market dominance forces and the second boom is led by science and technology dominance forces (Cheng and Zheng 2009). Li and Liu (2011) point out that, the industrial clusters based on cluster technology innovation networks can provide a long-term and stable competition and cooperative mechanism of technological innovation, reduce the cost of technological innovation, incentive to tacit knowledge's learning and communication, and provide an effective channel for the technology diffusion (Li and Liu 2011). Mao and Cui (2010) made an empirical analysis of technological innovation in industrial cluster based on innovative network (Mao and Cui 2010). The achievements of these studies are valuable for analyzing the technology innovation mechanism of industry cluster. And from the studies above, we can see that, the achievements about technology innovation of regional equipment manufacturing industry cluster is still less. So, further study on technological innovation mechanism of regional equipment manufacturing cluster is necessary and feasible (Mansfield 1998).

This paper analyzes the technological innovation motivation of regional equipment manufacturing industry cluster firstly, and makes a systematic analysis on technological innovation process of regional equipment manufacturing industry cluster in the following. On these foundations, this paper builds up a technological innovation system for regional equipment manufacturing industry cluster. Beside that, this paper summarized the influencing factors of technological innovation. This paper provides scientific basis and reference not only for researching tech-

nological innovation of regional equipment manufacturing industry cluster, but also for making economic policy by government.

## **8.2 Technological Innovation Motivations of Regional Equipment Manufacturing Industry Cluster**

### ***8.2.1 Profit-Driven of the Core Enterprise***

In order to protecting the dominant position in the market competition and pursuit excess profit, the innovation subjects must to do technological innovation activities. This paper argues that the purpose of equipment manufacturing enterprises is seeking for profit, and technological innovation is a very useful way to achieve its purpose. The core enterprises of regional equipment manufacturing industry cluster control most part of product supply in the market, though there is only a small number of the core enterprises. In technological aspect, the core enterprises master leading technology of the industry, and put their resources into technological innovation in order to keep competitive advantage and excess profit. Technological innovation brings huge profits for the core enterprises, and it also brings competitive pressure to other enterprises. Driven by profits, the other enterprises of equipment manufacturing industry cluster begin the imitation innovation, which is benefited by knowledge spillovers and technology diffusion. In this way, the technological innovation becomes more and more critical for equipment manufacturing industry cluster, and the technological level of equipment manufacturing industry cluster is improved.

### ***8.2.2 Demand-Driven of Market***

By analyzing the development of both domestic and foreign advanced equipment manufacturing industry, we found the equipment manufacturing industry is driven by domestic demand. Beside that, the domestic demand also supports the technological innovation activities of equipment manufacturing industry cluster. The market demand is more powerful than a “smart” government in promoting technological innovation of regional equipment manufacturing industry cluster (Sun 2010). The market demand is not only the source but also the ultimate goal of technological innovation of equipment manufacturing industry cluster, and it is the main external motivation of technological innovation. Market demands of technological innovation of equipment manufacturing industry cluster include these two aspects: one is the consumer demand of products and service of equipment manufacturing industry; another is demand of equipment manufacturing industry itself.

### ***8.2.3 Promoting Effect of Science and Technology Development***

Product of equipment manufacturing industry has a lot of characteristics, such as complex structure, high-level technology and diversification of single parts. These characteristics make the equipment manufacturing industry to be a typical technology-intensive industry. The huge profit caused by scientific progress and application of new technology becomes a powerful impetus of technological innovation of regional equipment manufacturing industry cluster. Recently, information technology has begun to infiltrate every aspect of equipment manufacturing industry, and the usage of high technology in upgrading and reforming the regional equipment manufacturing industry cluster become the trend. Science and technology play a fundamental and critical role in technological innovation of regional equipment manufacturing industry cluster.

### ***8.2.4 Guidance of Government Policy***

The policy of government is an important factor for guiding the technological innovation of regional equipment manufacturing industry cluster, and it is also an important impetus of technological innovation. Because most of the equipment manufacturing products related to the national security and national economic lifeline, government enacting a series of technological policies for guiding the technological innovation of regional equipment manufacturing industry cluster in order to set developing aims of technological innovation.

The policy of government has significant influence on input resources and passion of technological innovation of regional equipment manufacturing industry cluster; it is an important external motivation of cluster technological innovation. Beside that, the policy shows the development direction of equipment manufacturing industry, which towards greater profit (Li et al. 2010). In addition, motivation of technological innovation of regional equipment manufacturing industry clusters is depended on several factors: market system, economic environment and legal environment. And all the factors mentioned before are guided by policy of government. So, we can infer from the discuss above that, the regional cluster policy is important driving factor of technological innovation of regional equipment manufacturing industry clusters, especially for the cluster policy which is promulgated for particular region.

### **8.3 Technological Innovation Process of Regional Equipment Manufacturing Industry Cluster**

#### ***8.3.1 Decision Process of Technological Innovation***

With the development of regional equipment manufacturing industry cluster, its market demand and competition become greater than before for its long industry chain. The core enterprises in industry cluster start to innovate in order to meet the demand of external optimal selection and obtain the expected benefits. Firstly, the core enterprises evaluate the current technology innovation capability of the whole cluster. After that, the core enterprises identify the market demand and innovation resources of cluster. In this way, a preliminary innovation strategy is set up. Because of the characteristic of equipment manufacturing industry, such as high level technological content and technological demand, the core enterprises should establish contact with colleges and scientific research institutions in cluster if it necessary after making the preliminary technology innovation strategy.

#### ***8.3.2 Integration Process of Critical Resources***

The production of equipment manufacturing just like special equipment and common parts are technology intensive and capital intensive, and the development and production of them requires substantial resources, such as human, capital and innovation organizations both inside and outside of cluster. Effective usage of these resources, especially for knowledge resources has a direct relation with technological innovation of regional equipment manufacturing industry cluster. Knowledge resource in technological innovation of regional equipment manufacturing industry cluster can be divided into two types: explicit knowledge and tacit knowledge. Explicit knowledge facilitates communication and sharing, but tacit knowledge is stable and hard to be imitated or learned.

#### ***8.3.3 Process of Technological Development and Commercialization***

The specific market structure of regional equipment manufacturing industry cluster provides security of its technological innovation activities. Technological development of the core enterprises in cluster need technological assistant from supporting enterprises and related institutions, because of its long industry chain and industrial correlation. Interaction and cooperation on the value chain of the core enterprise include the following aspect: interaction between enterprises;

cooperation between enterprises and research institutions; cooperation between enterprises and intermediary institutions or financial institutions. The interaction and cooperation happened both inside and outside cluster are made by an integration team which includes experts, researchers and policymakers. Basic research achievements can be got through collaboration of the entire integration team, and they will be applied in products and services. The usage of the new research achievements in equipment manufacturing industry can significantly improve its quality and function, and bring innovation interest to the whole cluster. The consumers' demand for services and products can be conveyed to the innovators, such as production enterprises, R & D organizations, and basic research institutions through the demand effect; and this demand will guide the innovators' basic research. This process has a certain influence on the market structure, and accelerates the change of market demand. Under the stress of imitation and substitution, core enterprises have to keep learning in order to maintain technological superiority and innovation profit. Learning capability determines its competitive advantage for next round of technological innovation.

#### ***8.3.4 Diffusion and Upgrade of Innovation***

Technology diffusion is a process for disseminating innovative technologies among potential users by certain channels (Zhao and Wu 2010). Technology diffusion is more meaningful than technology innovation in the inside of regional equipment manufacturing industry cluster. Generally speaking, the leading enterprises master the new technologies of the industry cluster. For application the new technologies, the leading enterprises need to cooperate with related enterprises and supporting organizations, this cooperation extends the industrial chain and technological innovation chain. Beside that, application of new technologies promotes the learning and exchange among the innovation subjects in cluster. All these economic activities are bound to make technology diffusion from dominant enterprise to small and medium-sized enterprises. The technology diffusion makes rapid technological improvement of small and medium-sized supporting enterprises in industrial cluster. Corresponding, the technological breakthroughs of small and medium-sized enterprises are important supplement of the leading enterprises' technological shortages. There is technology gap between small and medium enterprises, and this gap can be filled by technology diffusion too. Under the role of the market, technology spread into similar enterprises continuously in industrial cluster, and the potential difference among different enterprises can be compensated, after that, a new round of innovation starts. The finally result of technology diffusion is that, cluster's technological level is strengthened and its technological reserve is increased. Diffusion and upgrade of innovation not only achieve collaborative innovation, but also accelerate the new round innovation and achieve circular upgrading of innovation.

## **8.4 Influencing Factors of Technological Innovation of Regional Equipment Manufacturing Industry Cluster**

The analysis above shows that, the technological innovation process of regional equipment manufacturing industry cluster is dynamic. In this process, many resources need to be integrated, managed and organized. Innovative aim of regional equipment manufacturing industry cluster is carried out through organized flow and interaction of the innovative elements and resources, and it is under the influence of various kinds of factors both inside and outside of innovative system. Some of the factors have directly influence on technological innovation activities, and they will be explained in details in the following parts.

### ***8.4.1 Input Factors of Technological Innovation***

Innovative input factors are prerequisite for technological innovation activities of regional equipment manufacturing industry cluster, because the input level of these factors is main symbol of practical creativity and potential output of technological innovation (Liu et al. 2008). Products of equipment manufacturing are technology intensive and capital-intensive products, and they need a lot of talent and capital support. Entrepreneurs play a critical role in technological innovation of regional equipment manufacturing industry cluster, so their qualities not only have a significant impact on technological innovation decision of cluster, but also show the direction and strategy of technological innovation. Innovation talent promotes the generation of innovation concept, ensure the inputs of information and resources of innovation processes, and ensure the liaison and coordination of activities in innovation processes (Yetim and Yetim 2006). The establishment of an effective mechanism of technological innovation, outstanding talent advantage, and increasing innovation fund are important conditions for making correct decision and ensuring smooth realization of the innovation process for regional equipment manufacturing industry cluster. In addition, the shortage of innovative inputs caused the shortage of technological innovation power of Chinese equipment manufacturing industry. So, more R & D talents and funds are needed. In this way, independent intellectual property rights of core technologies and common technologies of equipment manufacturing industry could be developed. And in this way, competitive advantage of Chinese equipment manufacturing industry could be obtained based on cost and resource advantages.

### ***8.4.2 Factors of Technological Innovation Capability***

The process of technological innovation of regional equipment manufacturing industry cluster is accompanied with technological change and technological realization, technological innovation capability is dynamic measure of the overall technological level of the cluster. Innovation capability of the cluster is formed and improved on the present foundation, and it plays a leading role in technological innovation activities. R & D capabilities of the core enterprises and collaboration supporting capacity of the supporting enterprises are most important parts of innovation capability. Better capability of technological innovation is helpful for obtaining techniques and integrating knowledge. In this way, the regional equipment manufacturing industry cluster could format the independent intellectual property right, build the core competence, and occupy the high-level segment in international division. Excellent manufacturing equipment industry can absorb and transform technology into innovation achievement effectively with low cost, and the flexible sales system and services system in cluster can quickly realize sales income, and capture the market (Xiang 2010). In the continuous technological innovation activities, constant improved technology and innovation capability affect the innovation as important input variables of cluster innovation system of regional equipment manufacturing industry.

### ***8.4.3 Factors of Technology Diffusion Channel***

Technology diffusion channel of regional equipment manufacturing industry cluster is a critical influence factor of its technology diffusion, and it is happened between technology suppliers and demanders actively. The technology diffusion channel provides a channel for diffusing technology form core enterprises to small and medium-sized enterprises. Technology diffusion channel plays a bridge role on the cluster overall innovation. Effective diffusion channels not only means fluent technological information exchange and excellent information dissemination, but also means rapid occurrence of technology spillover or indirect technology transfer. In this way, technology diffusion of regional equipment manufacturing industry cluster become more and more quickly. The effect of technology diffusion also accelerates the process of next round innovation. There are many channels for diffusing technology of regional equipment manufacturing industry cluster, such as import and export, international technology trade, domestic and foreign technology alliance and so on. In recent years, FDI becomes one of the most important channels of international technology diffusion. FDI achieves indirect transfer of technology and knowledge through economic activities about materialized advanced technology, and it is beneficial for the cluster to undertake foreign advanced technology. Therefore, regional equipment manufacturing industry



cluster should attract foreign investment actively, and establish foreign investment mechanism in order to obtain technology.

#### ***8.4.4 Organizational Factors of Technological Innovation***

Technological innovation process of regional equipment manufacturing industry is a coordinated and cooperated process between not only internal organizations but also internal and external organizations. Successful technology innovation of the cluster is a realization process of technology innovation of both the individual enterprise and the cluster. Therefore, to establish a reasonable and efficient technological innovation cooperation organization, strengthen the contact of enterprises, universities and research institutions within the cluster, promote the knowledge integration are important activities to achieve technological innovation aim. Common innovative organization models of cluster are learning organization, networked and virtual organization, but with the growing competition of international market, condition of market becomes unstable. So a new organizational form for technological innovation, which named technological innovation dynamic alliance become a better choice for regional equipment manufacturing industry cluster.

#### ***8.4.5 Factors of Government Policy***

Government policy is primary factor of technological innovation of regional equipment manufacturing industry cluster (Fu and Li 2009). The development process of equipment manufacturing industry in developed countries shows that, development of equipment manufacturing industry is inseparable from the government's policy. The main developed countries, such as United States, Germany and Japan, developed their equipment manufacturing industry later than Britain, but they transcend Britain ultimately, one of the most important reasons is the government attaches great importance to the equipment manufacturing industry. Government policy includes two aspects: policy support and policy regulation.

### **8.5 Conclusions**

This paper put focus on the technological innovation motivations and process of regional equipment manufacturing industry cluster, and build the innovation system. On this foundation, this paper summarized the key factors affecting the technological innovation of regional equipment manufacturing industry cluster. The conclusions of this paper as following:

1. Technological innovation of regional equipment manufacturing industry cluster is a dynamic circulative accumulation process, and it is driven by regional market competition and market demand, technical progress, guidance of regional policy, pursuit of max benefits of the core enterprises. The circulated process of technological innovation of regional equipment manufacturing industry cluster is: innovation decision-integration of resources-technology development and commercialization-technology diffusion and upgrade-innovation decision.
2. Technological innovation of regional equipment manufacturing industry cluster is composed of a series of activities, and these activities formed technological innovation system of regional equipment manufacturing industry cluster. This technological innovation system is a complex system, which related to a lot of interactions between different innovation subjects.
3. Realization of technological innovation of regional equipment manufacturing industry cluster is influenced by technological innovation input, technological innovation capability, technology diffusion channel, innovative organizations, and government policy. These factors influence the technological innovation not only in different way, but also at different degree. The most important and critical factor is technological innovation capability.

By analyzing the technological innovation mechanism, this paper mines the key influencing factors of technological innovation of regional equipment manufacturing industry cluster. Also, this paper provides scientific and theoretic basis not only for analyzing the technological innovation modes of regional equipment manufacturing industry cluster, but also for finding the ways to promote the technological innovation level and enhance the competitive advantage.

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