Research on Synergy Process & Mechanism of Technology Innovation in Industrial Clusters

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Abstract: Promoting synergy creation of technology in industrial cluster is the key of advancing innovation ability and technology level. The technology innovation of industrial cluster is synergy innovation process, according to the analysis for activities of innovation. And the paper explains the synergy process of cluster innovation activities. The process includes: technological decision and concept combination, technology development of combination involving production, teaching and research, popularization of technology and upgrade of innovation. Finally, the paper analyses the function of communication, choice, study and search for the process of synergy innovation.

Keywords: industrial clusters, synergy innovation, innovation process, innovation mechanism

1 Introduction

Industrial clusters have become a very important topic in international economic and business studies. However there is no single definition for a cluster. Porter (1990; 1998) defined clusters as a set of industries related horizontally and vertically having different kinds of interactions ending with greater levels of productivity. After this definition, there have been many other attempts to explain this concept. Although clusters can be elastically attached to any geographical scale (Porter 1990; 1998), it is important to distinguish clusters as a “local or regional dimension of networks”.

Industrial cluster is a complicated economic system. A certain successful technological innovation in cluster, generally popularized, must cause the changes of the industrial structure of cluster and structure of market, stimulate the new demand, and drive a more high-level technological innovation. In fact, technology innovation in industrial clusters is not a result of technology innovation of each enterprise, but under the drive of technology innovation of some enterprises and depended on synergy effect among enterprises, technology innovation achievement is spread, popularized and used. The technology innovation in industrial clusters is realized.

2 Technology innovation in industrial clusters -- synergy innovation

Synergy is inherent organizational ability in complicated system, it is the internal effort of forming the orderly structure of the system, and it can solve the transition process from unordered system to orderly one. Industry clusters can be considered that in a certain particular field, a large number firms of industries closely contacting each other and relevant support organization gather at space and form the phenomenon of the competitive advantage powerfully and continuously, i.e.: Industry cluster as one unique industry organizational form, is composed of a large number firms of industries closely contacting each other and relevant support organization. The study, adjustment and technology innovation of cluster system have broken the stability of industry's cluster. The structure and function of industrial cluster takes place revolutionary change; and the change process from unordered system to orderly one promotes the cluster to evolve into senior shape. On the one hand technology innovation in industrial clusters is the individual activities of particular department, particular technology, on the other hand it is the collective behavior, and the study among different departments and enterprises play an important role to technology innovation in industrial clusters. During technology innovation the synergy effect generated by competition and cooperation inside cluster guarantees the technological advantage of industrial cluster activity. The reasons lie in: First, some enterprises of industrial cluster promote productivity because of the technology innovation, and then get up to the demonstrative effect of
innovation. Second, inside industrial cluster, enterprises trust each other, form long-term cooperation, and the staff has informal, accidental, face-to-face and oral intercourse. All of these facilitate the spontaneous, unconscious technology communication among enterprises. Third, the technology innovation has promoted the research of fundamental science and applied science and make industrial cluster get new development. Fourth, because knowledge has spillover effect, the advantage in geography makes these competitive or complementary enterprises benefit each other in cluster. The technology innovation may improve the cluster’s knowledge; enhance the ability of achieving innovative resource and tacit knowledge, thus promote the development of innovative advantage of cluster greatly.

3 The synergy process of technology innovation in industrial clusters

The process of technology innovation in cluster is a collaborating and integral technological development course. The process of technology innovation in cluster focuses more on the synergy of “participant” and the connection of “course” and pays attention to the combination to resource, procedure among organizations.

3.1 Technological decision and concept combination
Because there are a large number of enterprises of the same trade in the cluster, and they compete with each other drastically for market and customers, the customers have opportunity to have the optimum choice and request higher standard to the products or service. It is a challenge to the present technological ability at the same time. The leading enterprises in cluster will catch this opportunity, survey the present technological ability of cluster, discern the market requirement and their own resource, produce and appraise the technological concept that can be substituted, choose a concept for further technological development and make the technological strategic policy. It is usually the description about standard, applicability and developing leading of technology. After defining technological strategy, the enterprises will cooperate with scientific research institution in cluster. The research institution and experts of university offer the thinking of technological development and development scheme suitable for choosing to enterprise through the small-scale technological experiment, and establish cooperation relation with the research and development (R&D) department of the enterprises. Meanwhile, the leading enterprises that have defined technological direction make up the group of technological concept combination (this group is made up of policymaker, scientific research personnel and experts) with experts of the scientific research institution together, combine many kinds of new schemes after considering the impact of different development schemes on technical design and production system.

3.2 Technology development of combination involving production, teaching and research
The technology development of leading enterprises is not isolated. The internal characteristic structure of market in cluster decides the connection among the upstream and downstream enterprises, so the technology development of leading enterprises certainly will require the technology cooperation of the Upstream and downstream enterprises, affiliated enterprises and institution. The leading enterprises of technology development cooperate with adjoining enterprises or organizations with the aid of convenience on geography; expand knowledge of technology innovation and capital stock, then form the innovative association about the new technology and related technology development. Through the cooperation efforts of many kinds of scientific research personnel, they propose many kinds of technical support schemes. These schemes may offer the practice guarantee for development of new technology and related technology. In addition, most research and development needs to be tested and adjusted on both apparatus of the laboratory and production equipment repeatedly for making the new technology meet the demand of the market progressively in the course of being used.

3.3 Popularization of technology and upgrade of innovation
The new technology of meeting market demand will be put into production formally with the aid of the
intermediary organizations and trade association. With the application of the new technology in network of the industrial cluster, the affiliated enterprises are increasing constantly and participating into cooperative R&D activity one after another, and then the technological innovation chain based on a certain new technology is being lengthened and stalwart constantly. The enlargement of scale in technological innovation chain of cluster has promoted the study and communication between the enterprises in cluster. The networked route internal cluster is constructed progressively. The networked study route help the technological affiliated enterprises to realize the dynamic and circulation of knowledge inside cluster. The synergy innovation has been realized among each component part in industrial cluster; the whole technology level has been promoted; and the technological reserve of cluster has been increased. Certainly the process of synergy innovation has influenced the structure of market to a certain extent, has accelerated the change of market demand, thus put forward the requirement for the technological innovation of new round.

4 Synergy mechanism of technology innovation in industrial clusters

4.1 Communication mechanism of guaranteeing the balance of technological innovation

The technological innovation in industrial cluster is a related process: the achievement of technological innovation not only displays the new technology that enterprises produce as the leading ones, but also shows the affiliated enterprises’ acceptable degree to new technology. The leading enterprises and affiliated enterprises communicate the information each other utilizing market relation and cooperative membership in cluster. The frequency of the information communication has a decisive impact on the development of the course and effect of technological innovation. The technology achievement of the upstream enterprises often becomes the input information of downstream enterprises’ technology innovation in the innovative chain. Technology communication helps the technological developing departments of the upstream and downstream enterprises to join together organically, downstream departments not only bring up feedback information to the technology scheme of the upstream enterprises depending on past experience and theory knowledge, but also the feedback may offer reference to concrete works ongoing of upstream enterprises. Meanwhile, there are a lot of innovative enterprises to participate in at each innovative stage, and involve a lot of affiliated enterprises. All of these enterprises carry on information interchange for overcoming all sorts of difficult problem about innovation too.

The long-term internal communicate and cooperative inertia may bring shoulder function to technology innovation. The communication process between the cluster members expresses that the upgrading of technological level in clusters depends on the contrast between the continuousness of technology innovation advantage and the changing cycle of technology structure. If the former is far greater than the latter, the latter changes is insignificant; the technological advantage will be lost if the degree is serious. So enterprises in cluster should launch the independence innovation actively under the environment of an open organization system; through the understanding to the changing demand of market, the enterprises should ascertain the localization of technological innovation in time; they should choose the rational technology innovation tactics and guarantee the advance of technology innovation. With the aid of the communication inside and outside enterprises, the enterprises in cluster should reduce the key rigidity caused by the reliance of the route. Communication mechanism of guaranteeing the balance of technological innovation should be established to realize the continuation of the technological innovation advantage in cluster.

4.2 Choice, learn and search mechanism promoting the transmission of innovation

Technology innovation in cluster results from the reciprocation between enterprises; it is the course of the cooperative effect between the enterprises with different information, skill, knowledge, ability, motive and values. That is to say technology innovation in cluster is realized on the condition of the choice, learn and search mechanism promoting the transmission of innovation.

4.2.1 Choice-- defining the direction of technology innovation

The choice to innovative technology of enterprises is the most crucial innovative activity to lead new
knowledge and new technology into the economic system of cluster. In the face of the new technological chance, it is full of uncertainty to innovate, and the association of the production factor has many kinds of possibility. The leading enterprises of innovation need to make the choice within many design plans or disposing of the technical development. Though the design of the new technology and adaptive capacity of the market are shown as the result that the leading enterprises of innovation and the affiliated enterprise choose together, it is the result that atmosphere, convention and market choose of the cluster act on together in fact. The contending common goals of enterprises in cluster are cost, resource, knowledge and competition, these form the study atmosphere, and they are the background of collective study and foundation chosen by the technology. Meanwhile, the realization that technology chooses needs good study convention to assist: the convention includes the circulation channel of technology, route of personnel exchanging, cooperating with each other, etc... Technology choose mechanism involves market factors include other factors too. The choose mechanism judges the adaptive capacity of market to the new technology and the potentiality of disposing, thus the enterprises determine what kind of technology innovation may be produced, developed, what kind can't. The choice will directly determine the way in which the new technology will be adopted, the direction, pace and scale innovated.

4.2.2 Study --- promoting the transformation of innovational achievement
The study between cluster members can be realized passing the R&D, produce, and solving problem activity between counterpart's enterprises, the upstream and downstream enterprises, affiliated enterprises in cluster, university and scientific research institution. The study can promote the existing innovative achievement to spread and make members share the technology knowledge each other. The affiliated enterprises study together because of common interests including “learning by doing” and “learning by using”. The related effect emerges through the identification to new technical standard and craft; after observing and duplicating products, technology, procedure between counterpart's enterprises, the enterprises obtain explicit and tacit knowledge, it is the effect of radiating. With the aid of interaction method the enterprises in cluster combine the cluster’s technology knowledge into their own system or change their own resource to imitate the new technology. Imitation is very general in the cluster environment. Main reason is that enterprises of the same trade clearly acquaint each other because of the approach in space. Meanwhile, the acquaintance makes the study cost drop greatly and obviously improves efficiency. The mutual study impels the cluster to obtain a series of new knowledge and changes the original knowledge foundation constantly. The innovational ability in industrial cluster gets accumulation. Individual or group achieve a series of special, secret, knowledge that cannot be explained in words, and the knowledge forms individuals or group's characterized knowledge foundation and technological ability. Study reflects the settlement course to the existing technological problem, is the course that technology is mastered too. Study can cause a series of innovation gradually, and establish the foundation for the fundamental innovation on higher level through the accumulation of knowledge and ability.

4.2.3 Search --- integrating technological knowledge
Enterprises have realized the grafting of the new technology through mutual study, imitation to the achievement of technological innovation. Usually, technology will be baled by its owner before grafting, the owner’s enterprises will omit and lose system knowledge, the tacit knowledge difficult to code and non-central knowledge passage that interrelate with their technology system. When the imitators face the knowledge baled, omitted or lost the enterprise's characteristic of innovative source, they should take out technology from the “bag” constantly, and search the related knowledge matching the knowledge passage constantly, in order to introduce the technological chance and change of external demand that are found during study into the production system. The tasks of the search activity are to restore the non-central knowledge passage according to the understanding of key technology, to catch greatly the new demand and technological chance, to develop some kinds of new technology that can meet the new demand, to improve existing technology at last. Generally, even if imitators are all fruitful to study the core technological knowledge and restore non-core knowledge, it is very difficult for the technology introduced to produce an immediate effect within short-term. Imitators' system knowledge is often difficult to support the technology introduced after all, and the production process is difficult to keep its due concordance. Then imitators must also adjust its organization, personnel's disposing, regulations,
etc., and produce as a trial for some time on this basis, in order to offer the learning opportunity of tacit knowledge, to examine the result of key knowledge study and restoration of non-core knowledge. The enterprises need adjust or produce the system knowledge matching on introducing technology at end. The technology introduced can “revive” to turn the knowledge that imitators grasp gradually after a period of break-in as a trial stage.

5 Conclusion

Mutual trust between members in cluster has reduced uncertainty, has promoted the communication about technological detail between leading enterprises and the cooperators, then cooperators become the new extensible subjects of technology innovation, and the validity of innovation action is strengthened. On the collective function of communication, choice, study and search mechanism, technological knowledge can be shifted among the adjacent fields; the innovation of a field will be caused the innovation of the adjacent fields having similar technology. Members of innovation chain suit the change of technical standard and optimize the technology structure by changing their own technology characteristic. The restructure between technology upgrading and technology matching makes innovation easier. The cooperation and division of labor between members are simultaneous with technology communication; the similar technology is repeatedly applied to the innovative activities of the different levels in cluster. Innovative chains of the different levels all do the best to guarantee their own technological advantage, realize the upgrading of the cluster’s technology through some optimization, and guarantee the flexibility of their innovation. In a word, the participation and cooperation of innovation subjects have made the enterprises of the cluster obtain necessary knowledge and message to innovate, have made different kinds of skills and knowledge together, have made the new technology match with market demand progressively, have improved the whole cluster’s technology, have promoted the technological innovation of industrial cluster.

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