

# The Cultivation of Cluster's Sustainable Competence Based on Knowledge Management

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## Abstract

The cluster has shown its powerful competitive advantages in global competition. However, as amounts of industrial clusters have displayed their competence, some have lost their competitive advantages in global competition. It is meaningful for clusters' development to cultivate their sustainable competence. This paper analyzes the sources of cluster competence. According this paper, the important ways to make cluster competence sustainable include transferring and sharing knowledge, making innovation in the cluster, absorbing knowledge from other outer sources, and cultivating unique and exclusive knowledge innovation capability that is differing from other clusters. This paper advances two ways for clusters achieving the transformation from closed knowledge system to open one: firstly, cultivate the capability of absorbing new knowledge from other local knowledge sources; secondly, improve the capability of knowledge share and innovation in the cluster.

**Keywords:** Cluster, Sustainable competence, Cultivation

## 1. Introduction

Since Marshall studied the cluster phenomenon, relevant discussion concerning with cluster competence has gained numerous attentions. Hengjiang Liu and Jiaoxiang Chen explain the meaning of cluster competence from aspects of factors, structures, and abilities (Hengjiang Liu, 2004, p2-9). Tichy (1998) summarizes the life cycle of industrial clusters based on the prosperity and decline of corporate clusters. Jiankang Huang (2004, p39-71) discusses the cultivation of industrial cluster's sustainable competence from an angle of competitive advantage rigidity. Pekka Yi Anttila thinks that cluster competence is chiefly coming from its innovation, learning, resource integration, and capability, emphasizing on improving productivity and innovation performance, exerting positive specialized effect, pushing positive externality and knowledge overflow (Pekka, 2004). Based on these researches and combined with theories of knowledge management, this paper discusses the cultivation of industrial cluster's sustainable competence.

## 2. Cluster competence

Porter is the representative of factor theory. Regarding the cluster as a unity, its competence is determined by four associated factors: corporate strategy, structure and competitor; demand; relevant supportive industries; factors situation, including climate, supply of labor and technology, payments, living costs, taxes, research institutes, official support, etc. These four factors affect one another, forming the industrial cluster competence. Ahuja (2000, p425-456), Krtke (2002, p27-54), and Tracey (2003, p1-16) are representatives of horizontal structure theory. In their opinion, enterprises in one cluster associate with one another in production, market, technology, purchase, and infrastructure. Meanwhile, there is a competitive and cooperative relationship between them based on fame, friendship, mutual dependence, and mutual benefit. Industrial cluster is kind of net organization with the property of economy, society, and self-learning. Industrial cluster competence is composed of degree of functional difference, net density, net cohesion, net integration, and net infrastructure quality. According to the theory of capability, cluster competence is chiefly coming from innovation, learning and sources integration, emphasizing on abilities of improving productivity and innovation performance, exerting positive specialized effect, pushing positive externality and knowledge overflow, enhancing corporate coordination effect, and occupying global market share (Pekka, 2004). All these opinions indicates that cluster competence is to take the cluster as one unity and investigate its level of competence in the global competition, emphasizing on how to integrate cluster's inner sources and adapt to outer environment.

Different schools hold different opinions toward cluster competence's sources (Bufang Wang, 2004, p12-16). Classic economics chiefly studies comparative advantages related with cluster industry based on division of labor, emphasizing on "special difference", namely the unbalanced distribution of non-flowing factors (such as mines, and certain production factors). New classical economics studies micro economic activities and macro economic growth under the assumption of perfect competition market structure and unchangeable production function returns to scale, regarding the flow of factors as instant and costing none. As economic operation strays away from original equilibrium, market economic system has a power of self-recovery. New classical industrial cluster theory emphasizes on knowledge overflow caused by geological closeness, and static and dynamic special externality. The typical transmit medium is the communication of labors (engineers, scientific researchers, and specialized workers in general) in cluster region. New trade theory probes into specialization and trade mechanism based on imperfect competition and idea of increasing return, which is similar to the conglomeration phenomenon discussed in theory of traditional economic geography. The representative fruit is Krugman's core-periphery modal based on increasing returns to scale, emphasizing on the cultivation of industrial cluster competence based on regional economic integration, market capacity, and law of increasing return to scale. According to new growth theory, the economic growth originated from endogenous technological progress is reflected by factors' increasing marginal return caused by the imbalance of regional economic growth, the technological externality generated by conglomeration, and the monetary externality, which will lead to the special conglomeration of economic activities. New institutional economics regards the cluster as a special result from enterprises' vertical decomposition, thinking that as enterprises achieve vertical decomposition, the level of external transaction activities will be improved. Enterprises that have economic relationships will gather together, what can help to decrease transaction costs. New economic sociology emphasizes fully on the effect of non-market relationship, such as trust, custom, cultural structure, and non-coded knowledge, among members in one cluster on industrial cluster. The source of industrial cluster's competitive advantage is changed from "economic factors", such as external scale economy, to "social-cultural regional root", such as the mutual effect of non-market forms that include trust and non-transaction independence. The school of competitive advantage, represented by Porter, thinks that cluster's sustainable innovation advantage is coming from cluster's organizational structure advantage, competition advantage, cooperation advantage, and cultural advantage.

To sum up, along with the evolvement of economic environment and competitive state, sources of cluster competence possess different features. For example, at the industrial economic times all scholars emphasized on cost advantages that are based on the appearance of cluster, which leads to consume less available materials, such as common facilities and resources. However, along with the development of times and the changes of competitive factors, knowledge becomes the key factor for corporate, regional, and national competition more and more. Meanwhile, because of further conglomeration of clusters and increase of environmental costs (such as pollution centralization), costs of material factors (such as land price in the cluster) tend to increase due to fierce competition and increasing participators. Costs of cluster based on material sources restrain its further development. In order to obtain competitive advantages for a cluster under the knowledge economy background, knowledge and technology becomes more and more important (N. Dayasindhu, 2002, p551-560; Martin Bell, 1999, p1715-1734). The competitive advantage of cluster exists in knowledge innovation capability.

### **3. The evolvement of knowledge and cluster competence**

Cluster competence's another important fruit is cluster's life cycle. Tichy (1998) thinks that industrial cluster has four life periods in one life cycle: the emergence phase, the growth phase, the maturity phase, and the decline or rigidity phase. It is showed in table 1 as follow.

According to table 1, at the growing phase and the maturing phase, the cluster has the most energetic vitality, the most powerful capabilities of knowledge learning and innovation, and the strongest competence. The knowledge accumulation of one cluster, as the initial conditions for its competence, determines the cluster's initial competence. The knowledge increment, as the representative of cluster's capabilities of producing and obtaining knowledge, determines the formation and improvement of cluster's dynamic competence. At different phases of cluster's life cycle, the important ways to sustain cluster's openness for the sake of extending its life cycle include knowledge transfer, share and innovation, absorbing knowledge from outer sources, and cultivating unique and exclusive knowledge innovation capability that is differing from other clusters.

Cluster's knowledge accumulation and knowledge increment determine the capability of cluster. Specific process is shown in figure 1. Thereof, T refers to cluster's life cycle, C cluster's competitive advantage.  $S_1$  reflects the evolving process of cluster competence under a closed condition. Curve  $S_1$  shows that at the primary phase of cluster's life cycle (the 0- $T_1$  part) the cluster advantage rises because of cluster's scale economy and share of public goods. After the cluster reaches the point of  $T_1$ , cluster competence begins to decline gradually and finally disappears because of

“regional lock”, cluster rigidity, loss of flexibility, and slow response to outer changes. As the cluster stays in an open system, its competence becomes sustainable by means of knowledge transfer, share and innovation, absorbing knowledge from outer sources and cultivating unique and exclusive knowledge innovation capability that is differing from others. The cluster competence’s declining time changes from  $T_1$  to  $T_2$ . In figure 1, it is  $S_1 \rightarrow S_2$ . Therefore, if a cluster pursues to obtain sustainable competence, its knowledge activities become extremely important.

#### **4. The cultivation of cluster’s sustainable competence: an open knowledge system**

According to former analysis, as the cluster arrives its declining phase, it begins to be aging and its competence decreases. Besides, the “regional lock”, cluster rigidity, loss of flexibility, and slow response to outer changes contribute to the decrease of cluster competence. New economic sociology pays more attentions on this issue. Institutions, in the essence, are frequent net mutual effect among people, having strong path dependence. In one cluster, institutions’ path dependence can provide with explanations for the emergence of effective customs and norms. Similarly, as the cluster’s outer technological conditions change, the path dependence of net may lead to sorts of lock effect in the cluster, and even the decline or death of the cluster (Jingjun Lin, 2004, p45-47). The most important reason for the decline of steel industrial cluster in Germany Ruhr are functional lock, recognition lock, and political lock caused by path dependence (Grabber, 1993).

Porter thinks that it is net structural hole that weakens cluster competence (Bufang Wang, 2004?, p12-16). Unilateral and powerful localized net may turn local cluster into a closed and rigid production system. On one hand, if the transaction relationship between enterprises benefit certain specific partner, the enterprise’ flexibility in market will become weak. For example, the excessive solidarity among enterprises in one local cluster will weaken not only the competition but also enterprises’ motive to pursue for development. On the other hand, the high similarity of connection structure will lead to the decrease of cluster net structure hole and homomorphism of net structure. As a result, local clusters can not get external new information and gain new opportunities. The rigid mechanism and the absence of innovation atmosphere will kill the possibility of cluster innovation. Because of the globalization of market and capital, knowledge activities should not be limited to paths in one cluster. It is a must to realize global knowledge learning and resource share and allocation, making best use of external knowledge sources based on localization (Bufang Wang, 2004, p12-16). The cluster has to turn the closed knowledge system into an open knowledge system in order to retain sustainable competence (N. Dayasindhu, 2002, p551-560). Martin Bell describes characters of closed and open knowledge systems. Based on his researches, we use table 2 to describe the two systems’ characters respectively.

In order to realize the transformation from a closed knowledge system to an open one, it is necessary to improve cluster’s capability of absorbing and integrating knowledge from outer sources, and capability of knowledge share, transfer and innovation. In specific, it includes two aspects.

##### *4.1 Cultivate the fundamental capability of absorbing knowledge from outer sources*

The knowledge rooted on cluster’s local cultural characters, especially the implicit knowledge, is the key factor for the cluster obtaining sustainable competence under the global competition. Therefore, it is necessary to cultivate cluster’s fundamental capability of absorbing knowledge from outer sources. In specific, it refers to the capability of identifying, absorbing, and using knowledge from outer sources. The fundamental capability of absorbing knowledge from outer sources emphasizes on assimilating new knowledge from outer sources and combining with cluster’s internal knowledge and culture.

Cluster’s absorbcency is determined by each subject’s capability of absorbing knowledge from outer sources and their mutual effects in the cluster. The absorbcencies of each subject in the cluster are different, which is based on present knowledge accumulation and technological abilities. The accumulation of capacities is the function of time, experiences, practices, and efforts. And the accumulation of capacities is a gradual process of path dependence. Although the subjects in one cluster stay in the same macro environment and experience, they have different technological levels due to differences in development practices, experiences, efforts, and history factors (Lin Li. & Ling Yuan, 2004, p80-84). The knowledge gatekeeper who holds higher capability of identifying and absorbing knowledge and capability of innovation is decisive for the improvement of cluster’s knowledge innovation capability. Because the cluster has a networked organizational structure that is right for knowledge transfer and communication, once new outer knowledge has been absorbed by knowledge gatekeeper, the new outer knowledge will be turned into the cluster’s common language by the knowledge gatekeeper, which will finally become implicit knowledge or semi-implicit knowledge that can be transferred easily in the cluster. Therefore, it is the knowledge gatekeeper who determines cluster’s capability of knowledge innovation. It has significant effect on the cultivation of cluster’s sustainable competence to cultivate and inspire enterprises in one cluster to turn into knowledge

gatekeepers. For clusters that are developed from institutions with knowledge advantages, the knowledge gatekeepers will come into being during the evolvement of clusters. For example, in the cluster that takes large enterprise as the core, the large enterprise will become the natural knowledge gatekeeper. But for clusters formed by small- and medium- enterprises, all members do not possess prominent comparative knowledge advantages. Therefore, the cultivation of knowledge gatekeeper becomes extremely important. To cultivate and inspire some enterprises in one cluster to turn into knowledge gatekeepers, the outer policies serve as important drives. The primary principle of these policies is to make knowledge leaders gain higher profits than the average.

#### 4.2 Improve cluster's knowledge share and capability of innovation

The cultivation of cluster's sustainable competence emphasizes on not only knowledge gatekeeper absorbing new knowledge from outer sources, but also the knowledge share among members in one cluster and the cultivation of innovation capability. Knowledge share and innovation capability are affected by characters of knowledge, knowledge receivers, knowledge senders, relationship of cooperators, knowledge transfer mechanism and reliable carriers and tools, and environmental factors. The cluster, as a typical net organization, has special advantages of knowledge share and innovation. For example, special closeness makes face-to-face communication more convenient (such as coffee bar effect). Public facilities decrease costs of knowledge share and innovation. Social net makes trust becomes possible. Embedment makes the communication of semi-implicit knowledge possess "mutually-identified group". All these provide with convenience for knowledge share and innovation. Along with the lapse of time, knowledge innovation capacity will be restrained. In order to cultivate sustainable knowledge innovation capability, we should make best use of network, artificial intelligence, neural net, group, and other relevant technologies to construct an open interacting technological platform, creating suitable "places" and platform that is right for knowledge share and innovation.

The more important is to inspire and cultivate cluster's knowledge innovation capability by constituting cluster policies (Hengjiang Liu & Jixiang Chen, 2004, p36-43). In specific, train and develop brokers (or medium agencies). For example, by founding scientific garden, we can create a platform for scientific researchers, entrepreneurs, and financiers communicating with one another. Set up business incubator and constitute cluster innovation system. Support public-private cooperation and enhance knowledge communication among enterprises. Make up rational system and guarantee for normal and frequent cooperation (but not occasional relation or level relation). Create an atmosphere of learning. Strengthen the knowledge overflow and net innovation mechanism. Perfect the training policy that can provide with intelligent support for labors in cluster, improving cluster's capability of knowledge share and innovation, which can endow the cluster with excellent technology base. The core of training policy is to establish the professional training program.

In the constitution of cluster policy, the government should make up proper cluster policy based on different clusters correspondingly. For the cluster that emphasizes on knowledge factors, the government should play a role of server, avoiding too much interference. The cluster policy should lay stresses on the knowledge and technological innovation and communication, the specialty knowledge and technological training, and the introduction of innovative intelligent capital, constructing a coordinative net among enterprises, and providing with exterior conditions for knowledge share and innovation in the cluster. But for the cluster that has a low degree of knowledge dependence, the government should take a part in the cluster properly. The cluster policy should lean to providing with infrastructure, public goods, services and capitals, and even wide professional training. By this way, the government can help the cluster improve its knowledge innovation capability and guide it to make strategic transfer toward the industry that lays more stresses on knowledge.

### 5. Conclusion

By analyzing cluster competence's meanings and sources, this paper concludes that the lock effect and the net structure hole are the main reasons for the decrease of competence as the cluster develops into certain phase. Therefore, the important ways to make cluster competence sustainable include: enhance the knowledge transfer, share and innovation; absorb new knowledge from outer knowledge sources; cultivate the unique and exclusive knowledge innovation capability that differs from other clusters. Based on that analysis, this paper advances two ways for clusters achieving the transformation from closed knowledge system to open one: firstly, cultivate the capability of absorbing new knowledge from other local knowledge sources; secondly, improve the capability of knowledge share and innovation in the cluster.

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Table 1. The change of the cluster's competitive advantage during the lifecycle

Life cycle	Characters of competence
Emerging phase	Competence comes into being but is short of stability; high specialization and prominent cost advantage; powerful economic energy; insufficient innovation capability; net effect between enterprises is weak and is affected heavily by environment.
Growing phase	Competence grows fast; more flexible production and stronger specialization; net effect between enterprises tends to be stable and begins to exert effects; improving innovation capability and brand advantage; government behavior and exterior new product's test-market begins to improve cluster's capability of adapting to environment and taking advantages over environmental resources.
Maturing phase	Stable competence, standard production, prominent effect of scale; collect lots of technologies and talents, and strengthen self-innovation capability; participate in international market competition, and occupy one-up market share; high credit of cluster brand; decrease of commercial costs; escape from environmental risks and catch market opportunities with agility.
Declining phase	Competence decreases; be stricken by sorts of risks; insufficient development vitality; capabilities of making product innovation, competing in international market and adapting to environmental changes decrease obviously; lose competitive advantages gradually.

Table 2. The characters of the closed and open knowledge system

Factor	Closed knowledge system	Open knowledge system
Base for knowledge diffusing in small enterprise	Emphasize on special closeness and passive knowledge overflow	Formulated and active cooperation
Dominant direction of knowledge flow	Horizontal knowledge flow: flow and transfer in enterprises that produce same products	Vertical: product's supply chain
Training institution's effect	None or temporary	Common or continuous existence
Task of large enterprise	Unimportant, non-structural, passive	Important, continuous, organizational cooperation, active
Knowledge capacity	Get and obtain knowledge from small-volume knowledge	Obtain knowledge from large knowledge capacity
Source of new knowledge	Chiefly created by subjects out of the cluster	Chiefly created by subjects in the cluster
Channels of external resources	Limited and informal channel	Common and formal channel, formal knowledge keeper
Types of learning	Learning as by-product	Searching with goals

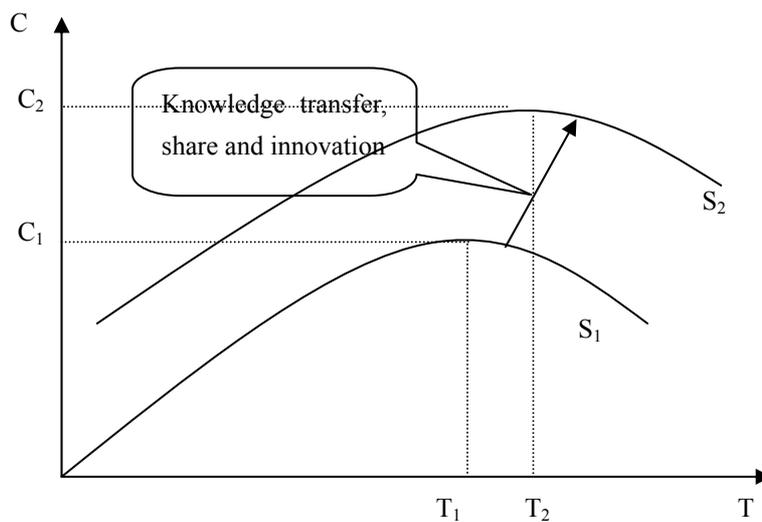


Figure 1. The Relationship between Knowledge and Cluster's Competitive Advantage