# A Study on SME Cluster Evolution Models and Institutional Arrangements "Ecological Communities" Perspective

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## ABSTRACT

Evolution of SME clusters is an ongoing innovation and industrial upgrading process, which formed in the region with a strong spirit of innovation and entrepreneurial culture, once formed will be in the causal effect of cumulative effects loop, the spontaneous evolution escalating. On this basis, this paper established a mathematical model to describe and analyze the evolution of SME clusters, whereby the SME cluster development model analysis of the problems and propose relevant cluster development policy design and system recommendations.

## KEYWORDS

SMEs; Enterprise clusters; Cluster evolution model; System Design.

# INTRODUCTION

SME clusters and biomes, as there are an evolution of the formation and development. Development of enterprise clusters is the role of business in the spontaneous behavior of the external environment and collective selection process, it also has the fittest, and the laws of evolution from lower to higher, with a self-organizing, adaptive and dynamic mechanism inherent coevolution. SME cluster follows the "competition - Innovation - imitation - gathering" cycle accumulation process is an evolving interaction going, dynamic process of self-motivation, and continue to achieve continuous innovation and industrial upgrading.

# SME CLUSTER EVOLUTION MATHEMATICAL MODEL

If the zone is assumed to be a point in space, then the equation: $\rho(t) = \rho_0 e^{-\int (\nabla \bullet v(t)) dt}$ can be approximated as a SME cluster evolution equation. Wherein, $\rho_0$ represents SME clusters initial variable $\rho(t)$ represents the level of development after $t$ time. $\nabla \bullet v(t)$ divergence in mathematics as representatives of resource gathering trend and speed to the cluster. This equation will be a point in the level of economic development with geographical coordinates initial endowment, the degree of concentration and the time businesses are good together, due to the addition of the time factor can be used to measure the evolution of enterprise clusters[1,2].

Through in-depth analysis of this equation can describe clusters of SMEs and self-reinforcing cycle of cumulative causation process.

First, to enhance the level of corporate concentration on the one hand and natural resource endowments and comparative advantages related to specific areas, but also with local unique social culture. Enhance the divergence to promote corporate concentration (ie, the absolute value of $|\nabla \bullet v(t)|$ divergence of growth), this process is both "natural" way to stimulate, and "artificial" way excited. This process is both "natural" way to stimulate, and "artificial" way excited[3].

Due to factors someone on the inside, so to enhance the divergence of this process is the key to the evolution of the cluster, and the divergence itself is from a single advantage (such as a good resource endowments, or economic system conducive to individual entrepreneurs) to expand to full advantage (due to corporate cluster brings various advantages) trigger. Resource endowments particular region may not be sufficient to generate enough divergence can not gather enough energy to enhance competitive advantage; But if the words "artificial" cluster advantages, it may soon reach a suitable divergence, which expands to full advantage[4].

Secondly, the divergence of $\nabla \bullet v(t)$ and corporate rate of change of the relationship between the degree of concentration of $\dfrac{d\rho}{dt}$ is entirely mathematical derivation, and it is the inherent nature of the relationship. This is demonstrated mathematically cluster process is a natural process of development, which is the SME market is the result of a spontaneous cluster speech.

Finally, the degree of divergence of corporate concentration has an initial stimulating effect, but companies will in turn act on the degree of agglomeration divergence. If a region of high rotation (corresponding to a very high margin businesses), will attract a lot of external resources, that is, there will be many companies, and the formation of clusters. If companies can generate external economies of scale clusters, then the development of the region is beneficial; But if produce diminishing marginal returns, so no other external force, the final outcome must be decreased investment yield of the entire region. If we add the assumption of perfect competition market, the end result is zero profit enterprises throughout the region. Divergence implies zero profit loss[5].

## THEORETICAL MODELS OF THE EVOLUTION OF SME CLUSTER ANALYSIS

General process of the formation and evolution of clusters of SMEs but also as a business life cycle, just going through birth, growth, maturity after which there will be three evolutionary path direction: one positive change, sustainable development that clusters achieve upgrade; Second, the reverse change, ie clusters demise, disintegration; Third, translation, namely due to cost or other reasons leading to the cluster transfer to other areas.
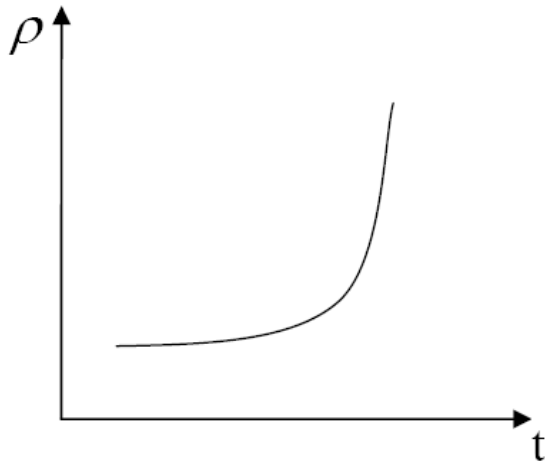


Figure 1 degree of agglomeration enterprise grows
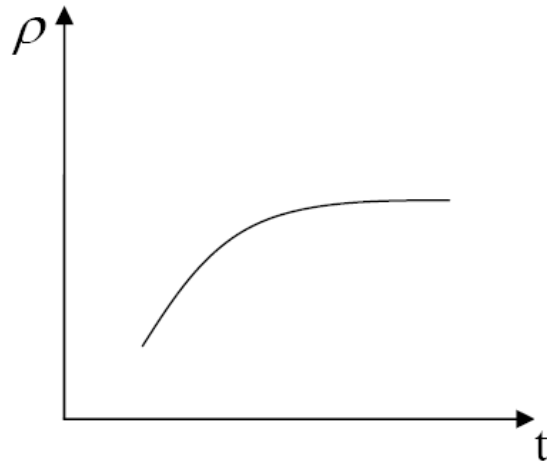
exponentially with time

Figure 2 business growth agglomeration degree

gradually decay

Figure 1, Figure 2 shows the initial point of the two development models. Figure 1 $\rho(t) = \rho_0 e^{-\int (\nabla \bullet v(t)) dt}$ model and better able to correspond to reflect the divergence remain unchanged exponential growth effects arising; Figure 2 reflects the divergence due to the diminishing marginal returns arising from decay (and fading rate than companies enhance the degree of agglomeration called), with the result that $\frac{d\rho}{dt}$ decreased over time, eventually showing low growth or no growth or even recession in the state. After the initial stage of the evolution of industrial clusters, agglomeration economies will attract a variety of new companies continue to enter the cluster, the cluster will enter the stage of development; at this stage, due to the interaction between enterprises and imitate isomorphic cluster will enter the convergence stage; the number of new entrants into the cluster of businesses and business growth will decline.
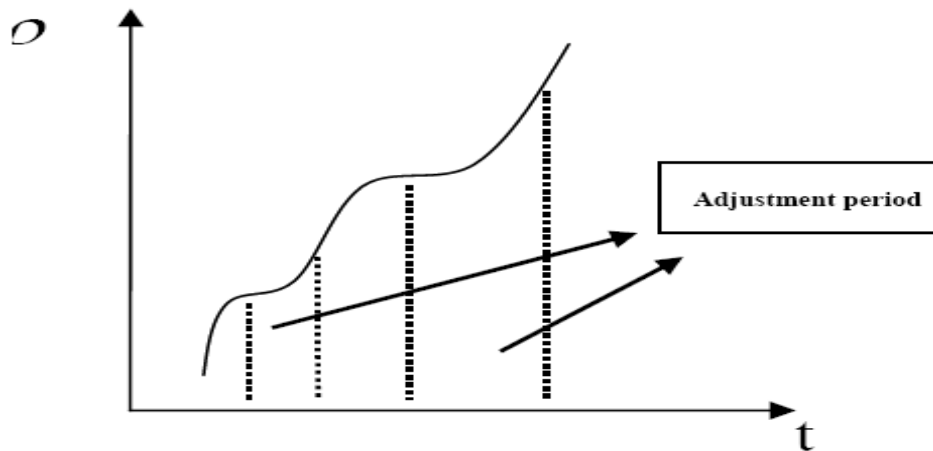
**Figure 3 degree of concentration with time corporate ladder growth**

In addition, the evolution mode can be shown in Figure 3, the degree of concentration with time that corporate ladder-style development, which represents the enterprise cluster continuous innovation led to industrial upgrading. The reason for this result is that at each stage, the divergence trend was attenuated such that $\frac{d\rho}{dt}$ downward trend over time; But every step into a place, through the cluster innovation, creating a new divergence, so that there are opportunities for rapid economic growth. So reincarnation, became for this mode. Self-organization within the enterprise industry cluster through continuous exchange of information with other companies occur, personnel distribution and transfer of resources so that the system is always in a highly dynamic and changing, so as to achieve the overall function of the organization, to achieve a higher level of organization. A mature business clusters will demise, depending adaptive enterprises in the cluster and the environment.

## CHINA'S PROBLEMS IN THE DEVELOPMENT OF SME CLUSTERS

Although China has been rapid development of SME clusters, but the size of the business is still relatively small clusters, competitive advantage comes mainly from the low cost, low price, less dependent on technological innovation, the lack of market awareness of enterprises or regional brands, it is difficult form the core competitive ability, thus affecting the sustainable development of enterprises cluster. Compared with the more famous in the world of SME clusters, clusters of SMEs in China there is a big gap in development, faced with the following key issues:[6,7]

**Evolution of SME clusters are in the stage of price competition**

Each cluster of similar enterprises are mostly simple "get together", a cluster of individual, family businesses small production accounts for a sizeable proportion of many entrepreneurs, farmers, product homogeneity, low degree of specialization, the lack of skilled workers, business suit follow the vogue, mainly in lower cost competition aspects, leading to widespread corporate profits, vulnerable to the impact of external market turbulence.

**Production technology and production organization simple, low product quality and added value, the lack of independent brands**

China is currently characterized by clusters of SMEs manufacturing ability and technical ability is quite weak, and large-scale industrial added value is quite low, large-scale hardware and software size is very small, stand-alone production ability and system integration capabilities but weak. Most enterprises are mainly low-tech products, high-tech and high value-added products small proportion. The key technology industry enterprise clusters mostly rely on the introduction and imitation of foreign technology, independent research and development of key generic technologies rarely. From the use of

knowledge perspective, the ability to use external companies within enterprise clusters of knowledge and information is weak[8].

## Lack of innovation, technological backwardness

Currently in China are mostly small and medium enterprises in the cluster lack of independent innovation capability, there is a "big but not strong" risk. First of all, most of our industrial clusters based on the application of technology-based applications simply because innovation investment risks, external resistance, in order to reduce the cost of R & D investment and innovation to reduce the risk, the multi-cluster technology used for the introduction and imitation, which mimic the motives far more than innovation motivation within the group of SMEs are willing to become "free riders", unwilling to innovation, continuous innovation and a general lack of motivation. Second, China's enterprises are mostly clustered mainly labor and capital inputs extensive clusters, the lack of internal research and development, design professionals, independent research and development capability is not strong, resulting in low value-added production in the region and the lack of competitive advantage in the industry. Third, the cooperation mechanism between enterprises and research institutions are not perfect, relying on its own research, or the introduction of foreign technology, digestion and absorption capacity without strong cluster lack of sustained development potential.

## SME cluster development policy recommendations based on the evolution of the cluster model

SME cluster formation and development of the market is the result of spontaneous evolution, their formation and development of its internal law, can not be artificially created by the local government, but that does not mean that the government of the SME cluster development totally ineffective. Potter said in 1999, when the Government to guide enterprises cluster development, "Do not go to disturb the market, distort competition, but should look for factors constraining cluster development, working to improve." Local government should grasp the essential characteristics of the cluster, become an important participant in the cluster, the cluster body - to provide a more conducive industrial agglomeration external conditions (such as public infrastructure, market mechanism, cultural traditions, etc.), to provide better public services, reduce transaction costs and innovative enterprises, actively promote the formation and development of local industrial clusters.

## Actively create social and cultural atmosphere conducive to entrepreneurship

Government should focus more on creating the overall policy environment above, including the elimination of all kinds of unreasonable charges, simplify procedures, change management system, providing excellent public services. On the one hand you want to adopt preferential measures to actively promote the development of industrial cluster development intermediary service system and technology service system, including the establishment of legal, accounting, arbitration, information consulting, testing and other aspects of intermediary service organizations for the effective functioning of the market economy system providing a lubricant; further reform and financial policies, and effectively solve the difficult problem of SME loans. On the other hand, should create or help create a variety of timely education and training institutions, vigorously develop vocational and technical education, to create the conditions for the formation of high-quality workforce in the industrial cluster. In addition, the government should strictly enforce standards of product quality and environmental safety, crack down on counterfeiting, strict performance requirements, product safety standards and environmental standards, attaches great importance to environmental protection, to create a sustainable environment for regional economic development.

## Hinder the formation of the market to break the barriers, prompting unity factor markets and product markets

Enterprise cluster formation process is the process of capital, technology, natural resources and human agglomeration. A closed market is impossible to form industrial clusters. Important reason for

China's industrial clusters mainly concentrated in the eastern coastal region is the eastern coastal region is the earliest implementation of open areas, the extent of its market is much higher than the Midwest.

### The establishment of small and medium enterprises as the core of the innovation system

Government to promote the development of SMEs in the cluster-focused service system for SMEs to actively promote and implement policies and regulations related to SME development and support policies. Technological innovation and the development of business-to digestion and absorption of technology investment incentives, and take measures against industrial clusters and industrial characteristics, technological innovation activities of the construction industry clusters industry technical support system, support and services throughout the industry cluster, and enhance industrial clusters competitive advantage.

### Promote regional brand building cluster, the cluster continues to expand market influence

To remain competitive cluster, not only big industries, companies need to do more, do ring brand. Excellent brand often represent a certain quality or other special properties. For those with OEM-based clusters, to push, moving companies shift from OEM to ODM way. Government should actively encourage and support the individual has a certain size and strength of the leading companies to accelerate the pace of corporate brand building, and continuously improve product quality and grades, by the provincial brand to a national brand and then to a world-class brand, gradually, and then play them demonstration effect leading companies to attract more companies to join the brand building, forming a brand echelon within the cluster.

Local governments can directly organize various activities to improve the visibility of the cluster, while strengthening oversight of the enterprises in the cluster, the cluster maintenance reputation. Such as by organizing professional exhibitions or fairs, advertisements in various media and other ways to do publicity to local industry clusters, expanding its market influence. To maintain the reputation of the cluster, the local government is also necessary to strengthen the publicity, so that enterprises pay attention to credibility within the group, the community and consumers establish a good image of a responsible; also required to increase the corporate image of the cluster detrimental punishment.

### Give full play to the role of industry associations

Industry associations and other service organizations to promote the role of technology innovation for industrial clusters mainly in his high degree of specialization, advanced forms of organization. As the gathering of expert information, technology, investment, management and other aspects, providing specialized services to help companies gain market opportunities and investment, can effectively reduce the risk of technological innovation, accelerate speed to market new technologies.

## CONCLUSION

### Evolution does not depend on the initial SME cluster resource endowments

A regional resource endowments may start a little advantage, relatively strong economic strength, reflecting the larger; initial endowment may not have the advantage of the poor economic development, reflecting smaller. But in both cases, the advantages of growing through the cluster process, inducing changes in divergence, in order to continuously gather resources. Divergence due to the impact on the economy is exponential amount of density changes, the impact of better than right, which ultimately can quickly expand into a full advantage. Thus, the key to building a cluster is to create economic advantages field divergence, in other words, is to make the economies of the region to become inputs to maximize output.

### To get rid of the decline of enterprise clusters, innovation is the key to upgrading

In the model to be seen as more dynamic comparative advantage concept, any existing comparative advantages are not worth too much nostalgia, despite the comparative advantage of the moment can stimulate higher economic field divergence, but with the passage of time, this excitation effect is bound to weaken or even disappear. Play an active innovation performance clusters continue to create and inspire new economic field divergence, enterprise clusters in order to achieve sustained and rapid development

## REFERENCES

**[1]** W.Mark, Johnson et al.; Harvard Business R.eview, **12,** 51-2 **(2008)**.

**[2]** Yu Yongda; Tsinghua University Press, 316-326.

**[3]** YongboSun; Management World, **7**, 182-183 **(2011).**

**[4]** Ji.an; Chinacirculation Economy, **2,** 72-75, **(2011).**

**[5]** Wu Dejin; Social Sciences Academic Press, 171-175.

**[6]** Wang Jun; Sun Yatsen University (Social Science Edition), **1,** 67-72 **(2011).**

**[7]** Baoliang Hu; Scientific and Technological Progress and Countermeasures, **2,** 95-100 **(2012).**

**[8]** [Japan] Masahisa Fujita; China Renmin University Press,115-134.