MANAGEMENT SCIENCE AND ENGINEERING
Vol. 4, No. 4, 2010, pp. 87-94
www.cscanada.org

ISSN 1913-0341 [Print]
ISSN 1913-035X [Online]
www.cscanada.net

The Study on the Self-organization Behavior about Enterprises Cluster

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Abstract: It appears to be a new approach of study that adopting the theory of nonlinear self-organization on the study of enterprises cluster. The emergence, development and growth of enterprises cluster can be satisfactorily analyzed in the theory of self-organization. The theory of self-organization originated from system theory is a result of transition from system theory to nonlinear science of complexity, and a theory of study on self-organization phenomena and laws. Dissipative structure theory deeply unearths the birth environment and conditions of self-organization and lays the foundation for the theory of self-organization; and synergetics theory intends to explain the process in which a system evolves from disorderliness to orderliness, which is essentially a process of self-organization inside the system. Synergy is a form and mean of self-organization. As a social system, enterprises cluster is a complex aggregation of multiple factors, themes and relations, has a series of conditions for self-organization, and its evolution is driven by the synergy among all the subsystems inside the system. On the whole, the process of synergetic evolution is normally the development from the evolution of competitive synergy to the evolution of cooperative synergy.
Key words: Self-organization; Enterprises Cluster; Dissipative Structure; The theory of synergetics; Mechanism of evolution

1. INTRODUCTION

As early as more than a century ago (1890), Alfred Marshall, a British economist, noticed the aggregation of industries in the division of work at specific areas, and called such "specific areas" as "industrial districts" and "specific places for the aggregation of various similar enterprises" (Marshall &Alfred, 1991). In recent years, most scholars prefer the term of enterprises clusters.

Due to different research backgrounds and objectives, scholars give different definitions to enterprises cluster. Doeringer and Terkla (1995) (Doeringer, 1995) define enterprises cluster as the geographical cluster of various enterprises to gain the performance advantages through their mutual cooperation; Rosenfeld (1997) (Rosenfeld & Stuart, 1997) defines that enterprises cluster refers to the cluster of various similar, related or complementary enterprises within a certain geological range, which enjoy the smooth sales channel and active communications and discussions, share the network of social relations, labor market and services, and share the opportunities and risks in the market. The concept defined by Michael E. Porter is now accepted most frequently and widely. He believes that enterprise cluster is a cluster of enterprises and institutions in a certain industry within a certain geographical range, which is stable and has

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*Received 10 August 2010; accepted 13 November 2010.

the continuous competitive advantages. (Michael, 2002) Later on, he further adds that enterprise cluster is a geographical cluster that should contain government, industry association, college, master mind and other institutions. (Michael, 1998)

So far, enterprises cluster is a hot research topic in the theoretical circles, in which the study on the mechanism of enterprises cluster is the focus. A large number of domestic and foreign scholars analyze it extensively from different approaches.

Marshall (1920) believes that industrial cluster must be caused by externality, so its inner mechanism should be studied with the focus on the close relationship between external economy and industrial cluster. Alfred Weber (1929) puts forth the concept of agglomerative factors. Subsequently, August Losch (1954) and P. Sargant Florence (1948) further elucidate the agglomeration economy. Paul R. Krugman employs his New Trade Theory to develop the viewpoint of agglomeration economy, which is still based on the increasing returns. UNCTAD (1977) discusses about the roles played by different cooperation modes in enterprises' capabilities and competitiveness and provides the policy proposals in connection with governments, enterprises and agencies. Lynn Mytelka and Fulvia Farinelli (2000) explore how to nurture the innovative cluster in the traditional industries and establish the innovative system so as to maintain the sustainable competitive advantages of traditional industries. J. Vernon Henderson, Zmarak Shalizi and Anthony J. Venables (2000) discuss why and how a cluster is formed in the industries and what consequences may be caused if any enterprise quits the cluster, etc. from the approach of economic development and geography.

In recent years, some domestic and foreign scholars adopt the theory of nonlinear self-organization to study the enterprises cluster, and believe that the emergence, development and growth of enterprises cluster can be satisfactorily analyzed in the theory of self-organization, which appears to be a new approach of study.

2. REVIEW OF SELF-ORGANIZATION THEORY

I. Prigogine initiated and applied the concept of "self-organization" accurately, "a system shall be considered as a self-organization if it is free of external interference during its process of acquiring the spatial, temporal or functional structure. The word 'specific' means that such a structure and function is not imposed on the system by outside world, and the outside world affects the system in an unspecific way". H. Haken further specifies that an orderly organization that is formed concertedly and automatically by a system when doing their respective duties in a tacit principle, if there is no external command, is considered as self-organization.

The theory of self-organization originated from system theory is a result of transition from system theory to nonlinear science of complexity, and a theory of study on self-organization phenomena and laws. Currently, it is not a unified theory yet, but a group of theories. (WU, 2001) It mainly contains: (1) I. Prigogine's Dissipative Structure Theory, which deeply unearths the birth environment and conditions of self-organization and lays the foundation for the theory of self-organization; (2)H. Haken's Synergetics Theory, which presents the inner mechanism in the formation of self-organization; (3)R. Thom's Morphogensis Theory, which particularly demonstrates the path of evolution of self-organization; (4)M. Eigen's Hypercycle Theory, which analyzes the specific form of self-organization evolution and the process of combination for systems; (5)Mandelbort's Fractal Theory, which identifies the similarity between the part and the whole of system so as to provide a very effective method for generating and understanding complexity; (6)and Lorentz's Chaotic Theory, which employs the Butterfly Effect[2] in the nonlinear determination formula to further reveal the origin of fractal structure from dynamics and the universal law of evolution for nonlinear system. Therefore, people have deepened their understanding of system existence and development, begun going beyond the range of closed system theories from the mechanistic perspective gradually and explained the conditions and mechanism of system evolution and development from different angles and levels.

[2] The Butterfly Effect refers that those tiny changes under the initial conditions may lead to a chain of long-term and major reactions of the whole system in a dynamic system

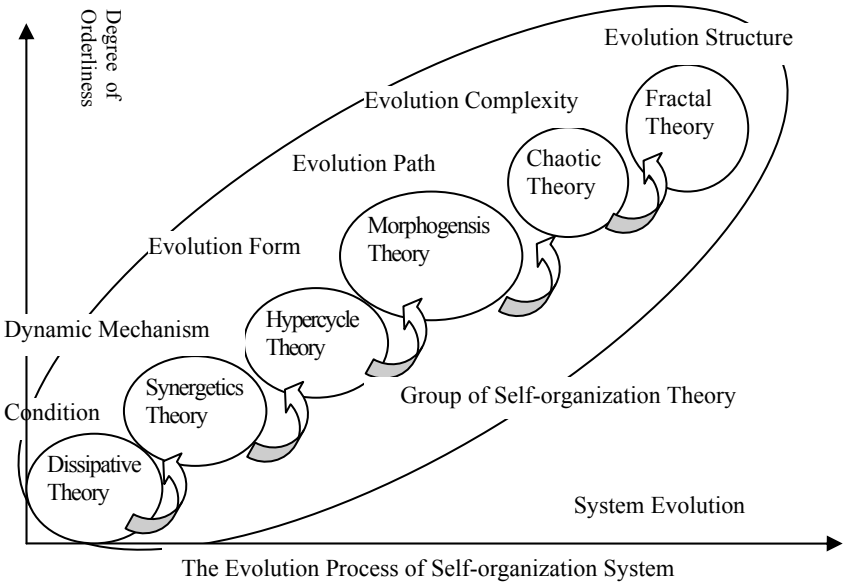

Fig.1: The Evolution Process of Self-organization System

Generally speaking, the evolution process of self-organization is a process in which a system experiences the continuous improvement of orderliness from simplicity to complexity, disorderliness to orderliness. Self-organization is a dynamic process, so it is a process of evolution from disorganization to organization, low degree to high degree of organization and simplicity to complexity in the same level.

In the field of economics, the theory of self-organization has been employed in the study on the complexity of economic system in the world ever since the 1980s. For instance, K. J. Arrow, et al organized a seminar on considering economy as a complex evolution system in 1988, and argued that economic system must have a core mechanism of dynamics, which could be defined by parameters of few dimensions and variables of multiple dimensions and dominate the evolution of whole economic system. (Arrow, 1988) After studying the economic balance and evolutional drive, W. B. Arthur has initiated the non-equilibrium and evolutionary nonlinear complex economics, and pointed out that the linear model frequently used in the economic analysis shadows the inner complexity and authenticity of economy. (Arthur, 1989) An economist Peters Edgar E. adopts fractal and chaos in the study on the financial market, tremendously shaking the analytic paradigm in the mainstream financial economics. (Peters, 1994) Some scholars represented by Cilliers P. employ the theory of self-organization to study the complex adaptation system in which multiple subjects interact. (Cilliers, 1998)

In recent years, a lot of scholars have started discussing about such organizations with the theory of self-organization, as the study on enterprises clusters has become a hot topic.

3. FORMATION OF ENTERPRISES CLUSTER AND SELF-ORGANIZATION CONDITIONS

In 1969, I. Prigogine, a Nobel Prize winner of chemistry, brought forth the notion of dissipation at the International Conference on Theoretical Physics and Biology. In 1971, Prigogine, et al published a book named *Thermodynamic Theory of Structure, Stability and Fluctuations*, which detailed the theory of Dissipative Structure. In 1977, Prigogine, et al published another work *Self-Organization in Non-Equilibrium Systems*, further developing the theory of Dissipative Structure.

When studying the process of a system from equilibrium to nearly equilibrium and then non-equilibrium, Professor Prigogine found that an open system, when it enters the nonlinear district away from equilibrium,

may move from stability to instability once a parameter in the system reaches a specific threshold, and experience a morphogensis due to fluctuation, in other words, non-equilibrium phase change. Therefore, the existing disorderly chaos is changed to a new orderly state. Such a new orderly structure formed in the nonlinear district away from equilibrium could be maintained by a continuous exchange of material and energy with outside world, and its stability would be kept by means of energy dissipation and not eliminated by any tiny interference by outside world. Prigogine called such a structure as Dissipative Structure and the phenomenon as Self-organization.

The theory of dissipative structure has, through the methods of thermodynamics and the system stability analysis, scientifically proven that an open system away from equilibrium can have a dissipative structure only if it has some conditions. These conditions include: 1. System openness, which guarantees the exchange of material, energy and information between an organization and outside world, and a system can be alienated from equilibrium only if it is sufficiently open; 2. System away from equilibrium, as a system in the state of equilibrium and nearly equilibrium cannot develop toward orderliness automatically, the away from equilibrium disintegrates the existing structure of the system rapidly and forms the dissipative structure by means of self-organization, which cannot only lead the system to orderliness, but also causes the diversified paths of organization evolution; 3. There must be an autocatalytic nonlinear interaction inside a system, since the nonlinear interaction among all factors can rapidly amplify any little difference or occasional fluctuation, and make the positive feedback viewed as a destructive factor from the approach of an equilibrium system become a constructive factor in the system evolution; 4. Effect of fluctuation, which drives a system to form a new orderly structure out of its existing structure, and whether the degree and range of fluctuation exceeds the critical state can be a decisive factor to judge whether the system has self-stabilization or self-restructuring.

If enterprises cluster, as a special sub-system of economic system, is carefully analyzed, it will be found that it has a series of conditions for self-organization.

3.1 Enterprises cluster is an open self-organization system (Markusen,1996).

It is firstly demonstrated that enterprises cluster is developed within a specific space of advantageous location. In the dynamic process, enterprises keep entering and quitting continuously, which maintains a certain degree of malleability for the organization structure of enterprises. It is secondly demonstrated that the existence of cluster must depend on the exchange of resources and the frequent exchange of labor flow, material flow, capital flow, information flow and other factors between enterprises cluster and external environment can form a negative entropy flow so as to cause the formation, maintenance and evolution of orderly structure in the enterprises cluster.

3.2 The enterprises cluster has a typical feature of nonlinearity (Ahokangs et al, 1992).

Linearity refers to the scaled and linear relation between quantities, which represents the regular and smooth movement in space and time; while nonlinearity refers to the relation that is not scaled or straight, which represents the irregular movement and morphogensis. The nonlinear system means the mathematical model of a system cannot satisfy the principle of superposition or may contain the nonlinear link. The enterprises cluster is a nonlinear system. Due to the effect of nonlinearity, a system can acquire new properties and realize the functions beyond the mechanical aggregation of functions owned by its member enterprises. Since they reduce the trade cost, obtain the scarce resources, share the knowledge information and eliminate the environmental uncertainty, etc. enterprises gather within a specific economic district, have the division of work in production, sales, R&D and service, etc., and adopt the nonlinear mechanism and participate in competition and synergism in certain rules and procedure, so as to maximize the common interests.

3.3 The difference of enterprises results in the enterprises cluster away from equilibrium (Daneke et al, 1998).

Due to their different capabilities of resource allocation, enterprises have formed the specialized division and cooperative relationship before, during and after production, alienating enterprises cluster from equilibrium. Moreover, the bigger difference between enterprises, the larger deviation from equilibrium and the more easily enterprises cluster forms the nonlinear system of competition and synergism. In this way, one or several trend(s) in the evolution of enterprises cluster develop a general trend in the end, so as to lead enterprises cluster to gain the overall competitive advantage by means of self-organization.

3.4 Fluctuation can help enterprises cluster realize the equilibrium development (Ivakhnenko A G et al, 1990).

In the evolution process, enterprises cluster will be inevitably affected by internal and external factors, which triggers the fluctuation in the self-organization of enterprises. Enterprises cluster should make full use of the effect of internal and external factors to create the conditions for self-organization and synergistic movement, form the active mechanism of fluctuation, avoid the trend of chaos and regeneration, facilitate the trend of orderliness and evolution and realize the equilibrium development maximally.

4. DYNAMIC MECHANISM OF ENTERPRISES CLUSTER SYSTEM

Synergetics, also known as synergism or science of synergy, is an emerging subject gradually formed and developed based on the interdisciplinary study since the 1970s and an important theoretical branch of system science. It was initiated by Hermann Haken, a professor in University of Stuttgart of the Federal Republic of Germany and a famous physicist. He put forth the concept of synergy in 1971 and discussed the theory of synergy systematically in 1976. He published *Synergetics: An Introduction* and *Synergetics: Introduction and Advanced Topics*, etc. The so-called synergy refers to the coordinative (collaborative) simultaneous development. In Haken's opinion, it refers to the associative action of multiple subsystems in a system. No matter how complex a system is, a synergism must exist only if there is the connection, cooperation or coordination among the behavioral agents or subsystems in a system. We define that synergy refers to the uniformity and harmony in the organic connection, cooperation and collaboration of various factors inside an object or a system in the process of connection and development.

Synergetics intends to explain the process in which a system evolves from disorderliness to orderliness, which is essentially a process of self-organization inside the system. Synergy is a form and mean of self-organization. Hence, it can be believed that self-organization is a fundamental path for a system to achieve the development from the disorderly instability to orderly stability and realize its self-improvement and self-development.

As a social system, enterprises cluster is a complex aggregation of multiple factors, themes and relations, and its evolution is driven by the synergy among all the subsystems inside the system. On the whole, the process of synergetic evolution is normally the development from the evolution of competitive synergy to the evolution of cooperative synergy. In the initial stage of cluster aggregation, a few enterprises start aggregation, take a competitive attitude for their own survival, and make efforts to gain the competitive advantage in order to win their identification in the market. Through such competition, these enterprises can learn from and adapt to each other, promote the level of enterprises, actually maintain the common interests between enterprises and gradually increase the scale of aggregation. When there is nearly a balance between a cluster's scale of supply and the demand in the market, there is objectively an obvious competition among the similar enterprises in a cluster in order to fight for clients and market, and they follow the mechanism of survival of the fittest and experience the reshuffling and restructuring in the cluster. Through such a process, the production and operation of enterprises in an enterprise will be further improved and their benefits will be further increased. What is more important, the awareness of cluster is developed extensively among the enterprises in the cluster in the process, so they gradually acquire a more cooperative attitude to gradually transit to next stage of cluster development—stage of cooperation and

synergy. It signifies that a cluster has entered the stage of sound progress. In such a period, the enterprises in a cluster develop the awareness of regional brand and start sharing the aggregative advantages brought by the cluster to a larger degree. A cluster network is formed by a large number of enterprises in a cluster, including upstream and downstream industry chains in the core structure, complementary enterprises in apposition, competitive enterprises in apposition, supporting system and external environment system. In order to protect the enterprises' interests and the whole interests of the cluster, the enterprises in the cluster will start the evolution of cooperative synergy.

In order to facilitate the analysis on the issue, we assume that there are two enterprises in an enterprises cluster. By means of the Lotka-Volterra model (SUN & CUI, 1990) in the ecology, the evolution of competitive and cooperative synergy among the enterprises in a cluster can be embodied in the following model:

$$\begin{cases} \dfrac{dN_1}{dt} = F_1(N_1, N_2) = r_1 N_1 \left(\dfrac{K_1 - N_1 - \alpha_{12} N_2 + \beta_{12} N_2}{K_1}\right) \\ \dfrac{dN_2}{dt} = F_2(N_1, N_2) = r_2 N_2 \left(\dfrac{K_2 - N_2 - \alpha_{21} N_1 + \beta_{21} N_2}{K_2}\right) \end{cases}$$

In which, $N_i \geq 0$ stands for the yield of enterprise i in the cluster; r_i stands for the natural growth rate of yield of enterprise i; $K_i > 0$ stands for the maximum yield during the independent survival of enterprise i under the condition of certain resources; $\alpha_{ij} \geq 0$ stands for the coefficient of competition between enterprises, representing the competitive inhibition of unit yield of enterprise j to the yield of enterprise i; β_{ij} stands for the coefficient of cooperation, representing the cooperative and reciprocal effect of unit yield of enterprise j on the yield of enterprise i, i,j=1,2.

(1) When $\alpha_{12}>0$, $\alpha_{21}>0$ and $\beta_{12}=\beta_{21}=0$, there is the competition between enterprise i and enterprise j, so the original differential equations should be changed to:

$$\begin{cases} \dfrac{dN_1}{dt} = F_1(N_1, N_2) = r_1 N_1 \left(\dfrac{K_1 - N_1 - \alpha_{12} N_2}{K_1}\right) \\ \dfrac{dN_2}{dt} = F_2(N_1, N_2) = r_2 N_2 \left(\dfrac{K_2 - N_2 - \alpha_{21} N_1}{K_2}\right) \end{cases}$$

(2) When $\alpha_{12}=\alpha_{21}=0$, $\beta_{12}\neq 0$ and $\beta_{21}\neq 0$, there is the reciprocity between enterprise i and enterprise j, so the original differential equations should be changed to:

$$\begin{cases} \dfrac{dN_1}{dt} = F_1(N_1, N_2) = r_1 N_1 \left(\dfrac{K_1 - N_1 + \beta_{12} N_2}{K_1}\right) \\ \dfrac{dN_2}{dt} = F_2(N_1, N_2) = r_2 N_2 \left(\dfrac{K_2 - N_2 + \beta_{21} N_2}{K_2}\right) \end{cases}$$

(3) When $\alpha_{12}\neq 0$, $\alpha_{21}\neq 0$, $\beta_{12}\neq 0$ and $\beta_{21}\neq 0$, there is the evolution of competitive and cooperative synergy between enterprise i and enterprise j, and:

①If $\alpha_{12}-\beta_{12}>0$ and $\alpha_{21}-\beta_{21}>0$, the effect of competitive inhibition is stronger than the effect of cooperative reciprocity between enterprises;

②If $\alpha_{12}-\beta_{12}<0$ and $\alpha_{21}-\beta_{21}<0$, the effect of cooperative reciprocity is stronger than the effect of competitive inhibition between enterprises;

③If $\alpha_{12}-\beta_{12}<0$ and $\alpha_{21}-\beta_{21}>0$, the effect of cooperative reciprocity is stronger than the effect of competitive inhibition imposed by enterprise 2 on enterprise 1, and the effect of competitive inhibition is stronger than the effect of cooperative reciprocity imposed by enterprise 1 on enterprise 2;

④If $\alpha_{12}-\beta_{12}>0$ and $\alpha_{21}-\beta_{21}<0$, the effect of cooperative reciprocity is stronger than the effect of competitive inhibition imposed by enterprise 1 on enterprise 2, and the effect of competitive inhibition is stronger than the effect of cooperative reciprocity imposed by enterprise 2 on enterprise 1;

If the above model is further expanded to a model for the evolution of competitive and cooperative synergy in a cluster of numerous enterprises, it is concluded as follows:

$$\frac{dN_i}{dt} = F(N_1, N_2, \cdots, N_n) = r_i N_i \left(\frac{K_i - N_i - \sum_{j \neq i}^{n} \alpha_{ij} N_j + \sum_{j \neq i}^{n} \beta_{ij} N_j}{K_i}\right), i, j = 1, 2, 3, \cdots, n$$

As indicated in the above analysis, only the close cooperation among enterprises can, in the evolution process of enterprises cluster, facilitate the overflow of benefits among enterprises and the prominence of synergistic effect in the industrial cluster. Competition is a preface to cooperation, so such a competition should be not a fight to death, but a contest of emulation, and the evolution of competitive and cooperative synergy is a drive to the development of industrial cluster. Only if the core structure, supporting system and external environment system in the system of enterprises cluster realize the evolution of overall synergy and all enterprises in a cluster can develop harmoniously, a cluster can grow stronger continuously and gain an advantageous position. Therefore, the transition from evolution of competitive synergy to evolution of cooperative synergy is the trend and law of evolution for enterprises clusters.

5. COUNTERMEASURES AND RECOMMENDATIONS ON FACILITATING THE EVOLUTION OF ENTERPRISES CLUSTER

5.1 Reduce the restriction, enhance the freedom of subjects in the cluster and facilitate the great development of enterprises cluster at the edge of chaos.

According to the theory of self-organization, a system is most creative and it is most possible to have all kinds of innovative activities when the system stays in the narrow critical state, in other words, at the edge of chaos. The persistent state is very stable and lack of vitality, so it goes against the mutual effect of subjects, the mutual learning of enterprises, the overflow of knowledge and the innovation of cluster; while the absolute state of chaos is too messy and disorderly, so the overmuch competition in a cluster damages the environment of survival for enterprises as the subjects of self-adaptation, which will result in the lack of trust among enterprises and affect the synergy evolution and cooperation among enterprises in the cluster. Thus, the optimal state for the development of enterprises cluster is the state between orderliness and chaos, or at the edge of chaos. In such a case, a system has the advantages of both orderliness and chaos, but does not have their disadvantages. Therefore, it enjoys sufficient stability but no rigidity, and has sufficient flexibility but little chaos. In this way, the vitality of enterprises and a cluster system can be sufficiently demonstrated.

5.2 Establish and perfect the supporting system for the development of enterprises cluster so as to realize the synergy evolution.

A supporting system is an extensional support of providing capital, technologies, talents, management and services for the development of enterprises cluster and a strong backup force to maintain the continuous development of enterprises cluster. It can provide the support for the development of enterprises cluster. A supporting system must achieve the coordinated development in correspondence with the development of core structure. Normally, an industrial cluster of self-organization starts attracting various service structures to join in gradually after its core structure is enriched and very strong to a certain degree, and its supporting system is improving gradually. Enterprises cluster is a complex system and its core structure must have the correspondence, joint development and synergy evolution with the supporting system, so as to realize the balanced development of industrial cluster. Overall, the supporting system relatively falls behind the core structure in various enterprises clusters in China, dramatically restricting the healthy development of clusters.

5.3 Promote the communication and cooperation between subjects in a cluster and facilitate the overall appearance of clusters.

The cooperation inside a cluster is vertically demonstrated by the cooperation between upstream suppliers and downstream clients, and horizontally revealed in the cooperation between complementary enterprises and the cooperation between competitive enterprises of the same kind. In the relations with suppliers, the sharing of profits can be realized by means of R&D outsourcing; or the orders can be increased to enhance the supplier's activeness in product and process innovations. Similarly, the cooperative relationship with clients is also of great significance, since clients are often the important sources of innovations. The close cooperation between clients and enterprises is one of fundamental elements and main channels for the continuous transmission of knowledge. Moreover, the cooperation between complementary enterprises is also very important. If there is no cooperation between complementary enterprises, they cannot achieve better development. The cooperation between competitive enterprises is the cooperation joined by competitive enterprises for their common interests, e.g. working out some regulations and rules, jointly following the market regulations and maintaining the normal order in the market, and jointly exploring the market, etc.

The extensive and deep communication and cooperation among enterprises in a cluster can greatly help absorb internal information and share knowledge so as to facilitate the integration of information and knowledge as well as innovation. After achieving the sharing of benefits and realizing the real profits through cooperation, it can also facilitate the further development of closely associative network under the effect of positive feedback, develop the habit of regular and irregular communications and evolve into a system culture of cluster, which can facilitate the overall appearance of clusters.

REFERENCES

Cilliers P.. (1998). *Complexity and Postmodemism: Understanding Complex Systems*. Routledge.

K.J.Arrow. (1988). *Behavior Under Uncertainty and its Implications for Policy*. D.E.Bell, H.Raiffa & A. TverSky(eds.). Decision Making.Cambridge University Press,497-507.

Marshall, Alfred. (1991). *Principles of Economics.* The Commercial Press, 280.

Michael E.Porter. (1998). Cluster and the New Economic of Competition. *Harvard Business Review,* 11,12.

Michael E.Porter. (2002). *Competitive Advantage of Nations.* Beijing: Huaxia Publishing House, 68.

PB. Doeringer, DG. (1995). Terkla, Business Strategy and Cross—Industry Cluster. *Economic Development Ouarterly, 9,* 225.

Peters Edgar E. (1994). *Fractal Market Analysis: Applying Chaos Theory to Investment and Economics.* John Wiley & Sons, Inc.

Rosenfeld, Stuart. (1997). Bringing Business Cluster into the Mainstream of Economic Development. *European Planning Smdy, 1*(1), 3-5.

SUN Guo-wei, CUI Qi-wu. (1990). A New Mathematical Model of Interspecies Competition—Expansion of Classic Lotka-Volterra Competition Formula. *Chinese Journal of Applied Ecology, 1,*31-39.

W.B.Arthur. (1989). Competing Technologies, Increasing Returns and Lock-in by Historical Events. *Economic Journal, 99,*116-131.

WU Tong. (2001). *A Study on Self-organization Methodology.* Beijing: Tsinghua University Press, 2.