The Study on Sustainable Development of Resource-Based Industrial Cluster: A Perspective from Organizational Ecology

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Abstract: As an industrial economic organization with specific characteristics, industrial cluster is emerging with strong dynamism in global competition and driving the development of regional economy. However, industrial cluster can bring some negative impact on regional economy development. This paper tries to illustrate the reasons for the stagnation and degradation of resource-based regional industrial clusters. Finally, it is suggested that the resource-based industrial cluster keep on sustainable development.

Keywords: industrial cluster, niche, organizational ecology

1. Introduction

Michael E Porter regards industrial cluster as an assembly of companies and organizations that are interrelated to each other and geographically concentrated in a certain field. Therefore resource-based industrial cluster can be defined as the geographical assembly of interrelated companies and organizations based on natural resources exploitation, as well as a cluster of interdependent companies which are geographically concentrated and its resource-based industry accounts for greater share. The natural resources here refers to mineral resources and resource-based industry includes not only the exploitation but also the preliminary processing of mineral resources (Wang Qingyun, 2003), for example, Anshan and Daqing in Northeast China, Datong in Shanxi province of China, Detroit in USA and Ruhr in Germany.

According to the industrial life cycle theory, the industrial development will go through four stages, that is, generation, development, maturity and recession. With the progress of time and technology, industrial recession is inevitable, however, the industrial life cycle can be prolonged or the industry can be transferred to a new life cycle in its transition from maturity to recession. For example, Ruhr in Germany, once the biggest industrial areas in Europe, after a nearly one-century boom, suffered from shutdown of coal mines and metallurgical refineries, decline of traditional industry, high unemployment rate and low economic growth. However, from 1980s, by means of structure adjustment and industrial transition, Ruhr reblooms and turns to be the successful transition model of resource-based industry cluster in the world. The resource-based industrial cluster assembles considerable capital for enterprises on one hand, on the other hand, it causes tremendous waste on resources and serious destruction on the environment. With the technological progress, this model will be replaced gradually, but those industrial clusters in present recession which were built up with large investment can’t be disregarded. In economic transition, how to restructure the industrial clusters with tremendous sunk cost and in difficulties, how to keep sustainable development and exert their power in the new economic environment is a practical and emergent task. This paper attempts to analyze the causes and interior mechanism of resource-based industry cluster degradation with the expectation of presenting proposals in the restructure of resource-based industrial cluster in present predicament.

2. The Study on Sustainable Development of Resource-based Industrial Cluster: A Perspective from Organizational Ecology
2.1 Introduction of organizational ecology
Organizational ecology is a study on the process of creation, growth and extinction of organizational population and its relationship with environmental change. Organizational ecology differs from other ecological theory in its emphasis on the diversity of organizations and adjustment in organizational community or organizational population. Organizational population here refers to a series of organizations undergoing similar activities, that is, they are similar in resources exploitation and operating results, organizations in the cluster compete for similar resources or clients. For example, resource-based industrial cluster is built up on the exploitation and preliminary processing of natural resources. To compete for the limited natural resources, enterprises and organizations in the cluster do their utmost to expand production capacity until the exhaustion of natural resources. Therefore, from the perspective of organizational ecology, those industrial clusters are faced with survival crisis.

Organizational ecology is mainly evolved from natural selection in biology whose analytical objects cover survival and adaptation in the organization, with the emphasis not on the evolution of individual organization but the change of the community of population.

2.2 Analysis of cluster degradation based on organizational ecology
Based on the fact that any organizations are supposed to rely on resources provided by external environment to survive, the western organizational ecology adopts the concept of niche to describe the particular resources space between populations that they don’t compete for. The niche is composed of all resources in which the population can survive and copy, therefore the niche can be seen as to support the resources assembly of a population, because the survival and development of different populations need the completely same, partial same or totally different resources, competition to different degrees will arise among different populations. The competition among populations can be described as “niche overlap” or “niche width”. Niche overlap refers to the state in which two or more populations compete for the same resources assembly, while niche width refers to the range of resources assembly to support a particular population or the specialization degree of resources utilized by a particular population. From the angle of ecology, the cluster is actually a community of enterprises composed of enterprises with similar characteristics and organizations co-exist with them. From the above analysis of cluster characteristics, it can be drawn that cluster change is a long-term process closely related to the environment. The range of ecological niche reflects the ecological width of the population. The wider the ecological niche is, the more resources the population occupies, and the stronger the population become in the competition.

From the ecological point of view, cluster effect takes place only when there are enough number of individuals in the assembly, that is, “the principle of minimum population”. The population exists in a moderate density, and over crowding or under crowding restrict the growth of population, in consequence, bring about the change in the number of population in time and space. Individuals in the cluster cooperate to improve their adjustment to the environment, when overcrowded, individuals compete for limited shared resources, besides, poison and physiological response produced by excrement has bad impact on the population, with the consequence of increase in death rate and decrease in population growth, that is, “crowding effect”. Moreover, to make use of limited shared resources, organisms produce adverse effect on each other, which is called competition. And this competition is divided into competition for resources utilization and competition for mutual interference. In competition for resources utilization, it is no the direct interference but respective consumption of shared resources from both parties that reduce the availability of shared resources, indirectly affecting the survival, growth and reproduction of both parties. Competition for mutual interference involves mutual competition among competitors, for example, striving for food, spouse and habitat among animals. For competition is closely related to density, competition can adjust cluster density. In this sense, the density of original enterprises in the cluster has impact on the variation in the number of cluster enterprises. By means of ecology, logistics model is used to describe the increase of industrial cluster:
\[
\frac{dN}{dt} = rN[(K - N)/K]
\]

In the equation, \( N \) is the number of enterprises in the cluster in Time \( t \); \( r \) is the natural growth rate of the cluster (that is, birth rate of enterprises-death rate of enterprises); \( K \) is the environmental capacity, that is, the permitted maximum of cluster growth in particular environment, \( K \) is decided by such environmental condition as resources and market on one hand and by specific industry on the other hand; \((K - N)/K\) is called residual space or unutilized opportunity for growth. Compared with the index growth equation \( \frac{dN}{dt} = rN \) in the finite environment, the correction term \((K - N)/K\) is added to the logistic model. This correction term is also called residual space or unutilized opportunity for growth, which means with the increase of enterprise density and the decrease of residual space (for example, resources), the environmental resistance such as crowding effect grows gradually, thus, the maximum unutilized opportunity for growth is on gradual decrease.

The rise of each enterprise in the cluster has inhibiting effect \( 1/K \) on growth rate, which is called crowding effect. When \( N \to 0 \), the correction term \((K - N)/K \to 1\), the residual space reaches the maximum and the resistance minimum, the maximum growth rate is fully realized. Meanwhile, \( \frac{dN}{dt} = rN[(K - N)/K] \to \frac{dN}{dt} = rN \), the growth rate is approximate to exponential form; on the contrary, when \( N \to K \), the correction term \((K - N)/K \to 0\), the residual space reaches the minimum and the resistance maximum, the growth rate tends to be zero.

Logistic model presents as a S curve (Figure 1) approximate to environmental capacity. With the growth of enterprise density, environmental resistance grows, cluster dynamism weakens, survival pressure of enterprises and cluster risk build up.

![Logistic growth vs Exponential growth](image)

**Fig.1 The “S” increasing model or cluster**

3. **Conclusion**

The above logistic model study on one hand proves that the density of original enterprises has impact on the increase of anaphesis enterprises in the cluster, that is, the density of enterprises in the cluster will affect the assembly of resources. When the cluster is approximate to its capacity, supervision should be adopted on the construction of new enterprises and the expansion of original enterprises. The government and trade associations are supposed to obtain such statistics as cluster density, fraternity death and new construction number and provide enterprises with related information. According to feasible evaluation made by neutral research institute on the expansion and construction of enterprises
based on environmental capacity, the government and trade associations should establish reasonable resources availability to prolong the life of resource-based industry cluster. On the other hand, it can be seen that providing the cluster resources remain stable, favorable policies can improve cluster capacity $K$ to prolong the transition from maturity to recession. By means of inclination industrial policies and financial policies, other corresponding policies, laws and capital assistances, enterprises can realize industrial upgrading and transition. The suggestions are as follows: shut down the heavily-polluted and resource-wasting enterprises and eliminate backward equipment and technique; encourage and support the development and expansion of enterprises with high technology and high utilization rate of resources; improve the ratio of transfer payment to resource-based enterprises; implement the tax-reduction system in sustainable industry and new emerging industry to make them develop with greater competence.

References