



Production Management

Elixir Prod. Mgmt. 57 (2013) 14046-14048

Elixir
ISSN: 2229-712X

The Industrial Competitiveness Analysis Based on Industrial Ecology View

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ARTICLE INFO

Article history:

Received: 18 February 2013;

Received in revised form:

17 March 2013;

Accepted: 2 April 2013;

Keywords

Industrial competitiveness,
Industrial ecological system,
Sustainable development.

ABSTRACT

Ecological industry is to realize the harmonious development between economy and environment by planning industrial systems according to material cycle in the natural ecological system. Industrial ecology competitiveness refers to the entire industry's emphasis on the ecological environment and interaction and the idea of harmony and co-evolution in all aspects of industrial production and management. With analogy analysis between natural and industrial ecosystems, the paper proposes some common comparability in structure, function and characters, and then this paper discusses some concepts and definitions related to the industrial ecology competitiveness, such as environment adaptation, industrial harmonious mutualism and resource productivity. The conclusion points out that industrial ecology system is the most effective sustainable and circular economy developing pattern.

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Introduction

From the perspective of productivity development, human society in its development history has experienced a primitive society, agricultural society, and industrial society. In this developing process, mankind has experienced the following stages: the fear of nature, the dependence of nature, the use of nature, and the conquer and transform of nature. At the same time, especially since human society entered the industrial society, people has constantly slaved and destroyed nature, of course humans has already paid heavy price, environmental degradation, environmental pollution, natural disasters, shortage of natural resources, low rate of recycling, energy depletion and so on, these ecological problems have caused enormous economic losses, affecting the social stability and environmental security. While focusing on high speed economic development, people begun to pay much attention to the increasingly serious ecological problems.

As the strategy of sustainable development is being widely put into practice, the research of industrial ecology has been aroused much attention in various countries' government, industrial and academic fields. Many experts and scholars (Debra L. Code, 2001) pay attention to resource conservation, environmental protection and harmonious mode between human and the natural ecosystem. Traditional economical growth pattern brings about resources depletion and ecology worsening by turning resource into waste incessantly. It ignores the organic connections and symbiotic relationship among different industries, and ignores transmission, migration and circulation of the materials, energy and information between social economy system and natural ecosystem. On the other hand, the improvement of industrial competitiveness is directly related to the labor productivity of a country and the raising of the level of

industrial safety and overall welfare of the people. Ignoring industrial competitiveness will make the country's national industry lose its survival and development opportunity.

To gain an advantage in the fierce market competition, the industry must satisfy consumers' demand for green and ecology product, increase transfer and use efficiency of materials and energy in the production process, and have a good relationship of competitiveness and cooperation with industrial upstream and down stream enterprises, even including competitive enterprises. In 1989, Frosch A. and Gallopoulos first proposed the concept of industrial eco-system. They pointed that "traditional industrial activity patterns should be transmitted into to a more complete model: industry ecosystem. In this system, energy and material consumption is optimized, waste discharge is minimized, and the waste of a production process becomes the raw materials of another production process". Rest of the present paper is organized as follows: With analogy analysis between natural and industrial ecosystems, the paper analyses that there are lots of common comparability in structure, function and characters, then the paper discusses some concepts and definitions related to the industrial ecology competitiveness, such as environment adaptation, industrial harmonious mutualism and resource productivity. At last, the conclusion points out that industrial ecology system is the most effective sustainable and circular economy developing pattern.

2. The analogy analysis of a natural ecosystem and an industrial ecosystem

(1) A natural ecological system and an industrial ecosystem have a high structural similarity

A natural ecosystem is composed of the non-biotic environment, the producers, consumers, and those restored. In the natural ecosystem, multiple organisms form a food chain and many food chains form a food web. An industrial ecosystem consists of the industry ecological environment, the producers, consumers and decomposers. Several companies form an industrial chain, many industrial chains form of an industrial network. A natural ecological system and an industrial

* The research is funded by National Soft-science Planning Program(2010GXQ5B287); Liaoning Economic & Social Developing Program(2013slktzjxx-16); Dalian Jinzhou Soft-science Planning Program(2012-D1-003).

ecosystem have a high structural similarity. An industrial morphology and a natural ecosystem have a high similarity in the morphology structure. In the trophic structure, a natural ecosystem delivers nutrition through the material flow, and energy flow. An industrial ecosystem has its industrial ventilation through capital flow, information flow, material flow, and energy flow.

(2) A natural ecosystem and an industrial ecosystem have high functional similarity

In a natural ecosystem, the biological components are directly and indirectly connected through the food web. Those connections are mainly through competition, mutualism, predation, etc. Competition is a survival struggle phenomenon which occurs between two or among more homogeneous or heterogeneous individuals when they compete for environmental resources and space. Mutualism is the phenomenon in which two biological or one could not live independently or without inside of another individual's body and they depend on and benefit to each other. Predation is the phenomenon of biologically uptaking other individual organisms (prey) in whole or in part for food.

In an industrial ecosystem, enterprises form a direct and indirect industry contacts and relationships through related industry chains and industry networks. These contacts and relationships also have the same business competition, mutual competition, and corporate predation etc. Enterprise competition is for those enterprises that share the same or part of the existing domain to compete for scarce resources of key production inputs for their own survival and development; Mutually beneficial competition is the competition among enterprises whose the profits or profit margins increase when the competition happens; Corporate predation is an enterprise annexation of another enterprise to expand the business scale and market share. Its purpose is to enhance the competitiveness and viability of the enterprise.

(3) A natural ecosystem and an industrial ecosystem have a high similarity of characteristics

Natural ecosystems and industrial ecosystems all have a good adaptability to the surrounding environment. Natural ecosystems and industrial ecosystems have the characteristics of a symbiotic and harmonious development. Natural ecosystems advocate improving the conversion efficiency of each energy level, while industry ecosystems advocate improving resource efficiency to increase the productivity of each product. Industrial ecosystems and natural ecosystems are very similar in their system structure, function, and features. The following table summarizes the corresponding relationships of the elements.

3. Industrial ecology competitiveness

The ecological way to develop the industry, to regulate the industrial with ecology goals, and to realize ecological industry is not only conducive to rational and efficient use of resources, but also improves the competitiveness of the industry itself and achieve a higher level corporate social responsibility. The so-called industrial ecology competitiveness refers to the entire industry's emphasis on the ecological environment and interaction and the idea of harmony and co-evolution in all aspects of industrial production and management with the higher utilization efficiency of resource production and less waste and emissions to establish a sustainable development of external comparative advantage. The definition includes the following four aspects:

- The industry needs a strong ability to adapt to the industrial environment, while minimizing the negative impact on the environment;
- The thinking of co-evolution must be reflected in the all aspects of industrial production and management, not just the requirements within the industry to work closely with each other, but also the co-operation with related industries and even competitive industry;
- The scientific and technological innovation in the production process must be continuously implemented, so is for the conversion and utilization efficiency of resources, and less waste and emissions;
- The competitiveness of industrial ecology not only emphasizes the strengthening of the competitiveness within the industry, but also seeks continuous improvement and sublimation for the competitiveness of the entire industry as well as the outer region which has the similar industries.

Tab. 1. Natural ecosystems and industrial ecosystems analog analysis

Similarity	Elements	Natural ecosystem	Industrial ecosystem
Structural similarity	morphological structure	Organism	Enterprise
		Food chain	Industrial chain
		Food network	Enterprise network
Functional similarity	Trophic structure	Material flow and energy flow	Capital flow, information flow, material flow, and energy flow
		Relationships	competition
Character similarity	Adaptation to the environment	Co-existence	Cooperation
		Predation	Supply chain
		Parasitic	Enterprise dependence
Character similarity	Harmony	Adaptation to the natural environment	Adaptation to the industrial environment
		Symbiotic harmony	Harmonious coexistence
		Conversion efficiency	Resource productivity

3.1 The ability to adapt environment

Industrial ecosystem is a relatively open system. The formation and improvement of the ability to adapt industrial environment is the result of the constant exchange of information, energy, and materials between the industry and its external environment. Environmental adaptability has become an important factor of industrial development. The industry with the initiative to adapt to environmental change will be more competitive. In the environmental factors in the uncertainty caused by globalization and information technology industries, the raw material market fluctuations, trade barriers adaptability, social responsibility, and industry-standard adaptability factors best reflect the industrial environment adaptability.

On one hand, as the energy supply becomes tighter, the ecological environment pressure increases further. The raw materials must adapt changes in the market for the rapid economic development, that is, pay attention to the recycle of substance use, improve resource utilization, develop the utilization of waste resources, and push the raw materials industry from resource-based to ecology-based. Thus, industrial ecology is to improve the raw material adaptability to changes in the market. On the other hand, the ability to adapt to the barriers to trade will become a strong competitive advantage in the industry. The core to response to trade barriers is industrial ecology which is the reflection of the safety, health, harmless,

non-polluting, energy-saving and resource conservation for the whole production and recycling process. Under the guidance of the theory of industrial ecology, reasonable and appropriate measures of the environment "damaging" cost actually contained in any products should be taken. We can not seek short-term economic interests at the expense of the natural environment; therefore fundamentally improve the adaptability of the industry to respond to trade barriers.

3.2 Cooperation symbiotic ability

In a natural ecosystem, to better survive, different organisms form different biomes based on category and geographical conditions and achieve co-existence and co-evolution under certain food chains. In an industrial ecosystem, enterprises in the same ecological industry chain would come together to form industrial clusters under the impact of external factors or market evolutionary forces, and achieve co-existence and co-evolution with certain value chains. The actual nature of the system is a symbiotic system. This system is composed of enterprises which are complementary with symbiotic relationship from each other and form a community with common interests and goals.

The industrial harmonious coexistence is not emphasizing the symbiotic strength of the competitiveness of a single unit within the industry, but to seek the whole industry growing competitiveness and sublimation. Industry harmonious coexistence capability is a necessary condition for the industry sustainable development.

3.3 Transformation capacity of resources

Human's industrialization process has made a serious shortage of ecological environment and natural resources. As a result, many countries have yet to achieve industrialization and their further development has been severely restricted because of the shortage of resources and environmental issues. Industrial ecosystems are ongoing to unify energy conversion and material recycling movement. Material and energy flows along the industry ecosystem chain move step-by-step and level-by-level to form a circular structure among raw materials, energy, waste and other environmental factors. Therefore, the making use of energy and resources are maximized in the reciprocating cycle and the added value of waste resources utilization is also achieved.

On the one hand, by increasing the circulating transfer process, the system is more likely to be stable and more conducive to the repeated use of substances, which can improve the productivity of the system. On the other hand, the resources in the industry chain keep extending and the full use of substances can be achieved and value can be added. Industry ecosystems improve utilization of resources and energy, effectively reduce the cost of industrial production, and thus achieve a good industrial eco-efficiency.

3.4 Sustainable development and social responsibility capabilities

The core concept of sustainable development is sustainability, emphasizing the social, economic, and environmental development. While industry creates wealth and meets the needs of the society, as a social citizen, it has the social responsibility to the sustainable development of resources and the environment. Corporate social responsibility is considered as a company's contribution to sustainable development, linking the protection of ecological environment into the industrial development strategy, focusing on the social responsibility of industry, and implementing environment-friendly development strategies. An important way for an industry to fulfill its social responsibility is to realize industrial ecology, that is, based on the renewable natural ecological environment for human survival and development, "human-society-nature" develop coordinately and sustainable (Wilderer PA, 2007). This imposes that an industry will organize all its economic activities from the beginning with the mode of the natural ecosystems. "Resource-products-consumers-renewable resources" becomes the material repeated recycling process to achieve the low input of natural resources, high utilization of waste and low emissions, and the optimization of ecological and economic benefits.

4. Conclusion

Industrial ecology has the characteristics of both natural science and social science. The core essence of the eco-industrial system is the layer of material circulation and delivery of energy use, not only to solve environmental problems, more to solve the problem of scarcity of resources or resources of economic efficiency, that is, resources of the correct disposal and efficient use problem. Therefore, the ecological industry is a new, sustainable economic developing model, and has great high marketing ecological competitiveness.

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