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Yadong Jiang
Department of Information Management, Hohai University, China, joehhuc@yahoo.com.cn

Wanying Shi
Department of Information Management, Hohai University, China

jing Sun
Department of Accounting, Hohai University, China

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The Research of Health Assessment of E-business Ecosystem

Jiang Yadong[1]⁻ , *Shi Wanying*[1] , *Sun jing*[2]
[1]Department of Information Management, Hohai University, China
[2] Department of Accounting, Hohai University, China

Abstract: The e-business ecosystem may be deviate from the equilibrium state in its development process. In this article the authors defined the e-business ecosystem health by combining ecological principles, and developed ecological indicators of e-business ecosystem health. The method of ecosystem health assessment (include biodiversity index method and index of biological integrity method) was introduced in the field of e-business and was used in B2B e-market analysis as a preliminary evaluation example.

Keywords: e-business, ecosystem health, assessment

1. INTRODUCTION

With the economic development, e-business is no longer a simple electronically transaction between the seller and the buyer. The e-business ecosystem is gradually forming with the following features: being Internet-business centered, gathering a large number of customers and other service organizations to connect with each other, promoting each other and integrating resources through the Internet platform.

Currently, related research on e-business ecosystem has been done [1] [2]: comparing it to traditional business ecosystem, summing up the stages of its evolution, and discussing the construction of e-business information ecosystem. However, research on e-business ecosystem health and its evaluation is still in a blank stage. Under such a situation, we make a definition of e-business ecosystem health, discuss the criteria and methods of system health assessment, and analyze the health of a B2B e-business ecosystem as an example.

2. E-BUSINESS ECOSYSTEM AND ITS HEALTH

2.1 E-business ecosystem and its components

Ecosystem means that life is a process of material, energy and information exchanging between organisms and environment. In 1993, Moore first proposed the concept of business ecosystem. Business ecosystem is an economic union based on the interaction of the organizations and individuals. The union includes a large number of participants, and each participant must rely on each other to survive [3].

E-business is a special form of the business ecosystem. It is an organic ecosystem composed of a series of closely related businesses and organizations which is beyond the geographical boundaries. With the Internet as a competitive and communication platform, participants share resources and complement with each other through a virtual, union method [4].

E-business ecosystem is composed of 'Species' members, they each perform their own functions. The ecosystem is continuously in the exchange of material, capital and information, in order to promote smooth development of the entire ecosystem. The 'Species' members can be divided into the following four categories according to their positioning (Figure1):

- Leadership populations. That is the core of e-business enterprises.
- Key populations. That is e-business transactions subject.
- Support populations. That is the organization which online transactions must adhere to.

⁻ Corresponding author. Email: joehhuc@yahoo.com.cn(Jiang Yadong)

● Parasitic populations. That is enterprises that provide value-added service for online transactions, such as online marketing, technology outsourcing, e-business consulting firm and so on.
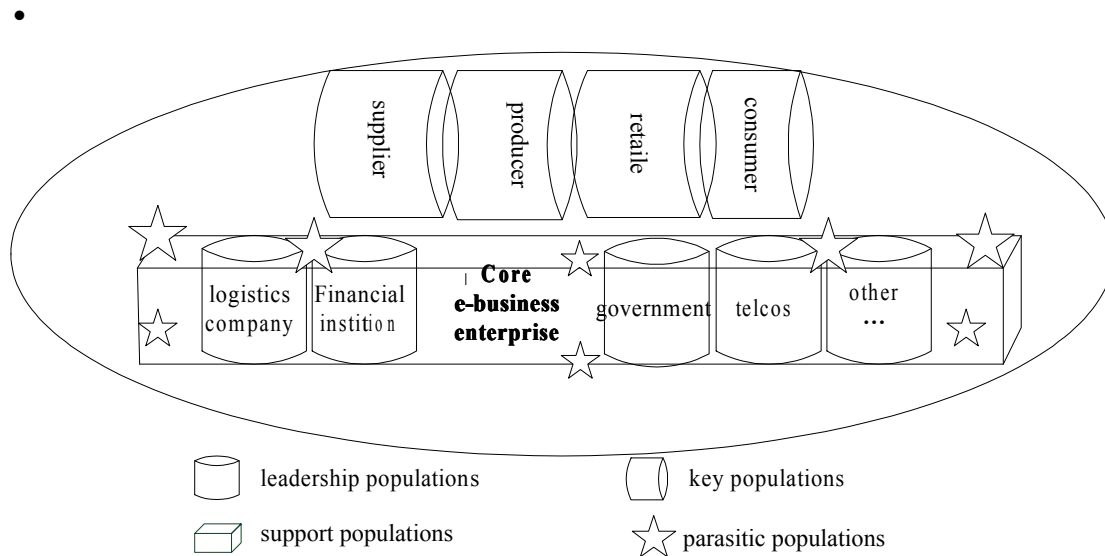
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Figure 1. The components of e-business ecosystem

2.2 Health of e-business ecosystem

Ecosystem health is an integrative field exploring the interrelations between human activity, social organization, natural systems, and human health. An ecosystem is healthy if it is stable, sustainable and active. A healthy ecosystem should be able to maintain its organization, resilient to stress and auto-recovering after being threatened over time. Five basic ecological axioms should be obeyed if an ecosystem is healthy: including the axiom of dynamism, hierarchy, creativity, relatedness and differential fragility [5].

With the concept of ecosystem health, a healthy e-business ecosystem should be vigor, with the ability of self-renew, self-recovery and buffering the external environment impact. And it should be able to maintain the integrity of its structure and function, providing sustainable ecosystem services for human survival. A healthy e-business ecosystem should follow the following five basic ecological axioms:

● The axiom of dynamism. An e-business ecosystem always changes over time. It has a closely connection with the surroundings and ecological processes. And it always automatically tends to be member diversity, structural complexity and function perfect. The ecosystem will sooner or later enter the mature stage of stability, as long as there is enough time and conditions. The manager should pay much attention to this dynamism and adjust the manage strategies to adapt to the ecosystem.

● The axiom of hierarchy. Various sub-systems of e-business ecosystem are open. Many ecological processes are not all equal. There are upper-level or low-level, also containing type or non-containing type of an ecosystem. For example, Alibaba e-business ecosystem is included by the B2B e-business ecosystem. Management policy should be acted according to circumstances. Like the B2B e-business ecosystem which contains a number of sub-systems, can be called an upper-level e-business ecosystem. The global e-business ecosystem is the largest e-business ecosystem. Like the Alibaba e-business ecosystem which contains only one core e-business enterprises can be called a low-level e-business ecosystem.

● The axiom of creativity. E-business enterprises are the core of self-adjust process in an e-business ecosystem. The process is creative. Multiple functions are the source of the creativity.

● The axiom of relatedness. All ecological processes are interrelated in an e-business ecosystem. An impact on the ecological processes will have an impact on the entire system.

• The axiom of differential fragility. A health e-business ecosystem can buffer the interference caused by external stress, with a certain resistance to stability of its internal organizational structure. It is in a condition of automatic adjusting to balance. The ecosystem will not collapse until the external stress reaches a predetermined critical value.

3. HEALTH ASSESSMENT OF E-BUSINESS ECOSYSTEMS

According to the axiom of dynamism, e-business ecosystems will gradually tend to be complex and perfect. Thus its management also is dynamic, systematic and complicated. As it is in a complex economic environment, one mistake can cause the whole e-business ecosystems collapse. So e-business ecosystem is facing huge pressure.

Research on ecosystem health is the product of the ecosystem pressure .It is the guarantee of maintaining system stable, keeping its vigor, improving the quality of human life. A healthy and stable e-business ecosystem is important for enterprise survival and development. An evaluation and analysis for e-business ecosystems health helps the enterprise to do correct decision-making.

Now, methods of ecosystem health assessment include indicator species method and index system method. Indicator species method is based on the diversity and richness of indicator species. Index system method is to establish an index system based on the characteristics of the ecosystem and its service function with mathematical method.

3.1 E-business ecosystem health assessment criteria

From the view of ecological effective operation, each key business domain must be healthy in products or providing service. If an ecosystem does not have enough productivity and vigor, and human-need can't be satisfied, the ecosystem is obviously not healthy. Even if it satisfied human-beings, the ecosystem is also not healthy if the whole ecosystem would collapse when the environment meets destructive changes. So with the help of ecosystem health assessment theory, e-business ecosystem health can be evaluated by the following eight criteria:

• Vigor. Vigor means the growth and development of producers, communities cover and the level of primary productivity in ecosystem. For e-business ecosystem, vigor is the company's production capacity. It means the effectiveness from raw material into a living organism. The speed, investment utilization, performance and other aspects of from technology into new products are different. These all reflect the different system vigor in e-business ecosystem.

• Organization. The organization is the complexity and diversity of the e-business ecosystem's structure. According to the axiom of dynamism, e-business ecosystem always auto to the e-business diversity, structural complexity and function perfect direction of evolution. This can improve the maximum external environment stress value of the system.

• Resilience. The resilience is that the e-business ecosystem has the ability of gradually recovering when the external stress disappears. If the ecosystem lacks enough resilience, external stress will result in a deviation from the balance state of the ecosystem. Then the e-business ecosystem may collapse. The resilience includes the recovery of the productive forces and production structure (species composition).

• The maintenance of the e-business ecosystem services. It refers to the ability to keep providing the social service functions. A healthy e-business ecosystem should be able to fully provide these ecosystem services.

• Creativity. It means a healthy e-business ecosystem can explore many potential service functions. The creativity of service system and production technology can improve productivity and human satisfaction. A degraded e-business ecosystem will not have this feature.

• Input Reduce. E-business ecosystem does not require a lot of inputs to maintain its productivity .A

healthy e-business ecosystem should have the characteristics to minimize inputs per unit of output without increasing the risks to human health.

• Impact on neighboring systems. A healthy E-business ecosystem will not destroy neighboring systems during operation .If they rely on their advantage and market information asymmetry, to destroy other systems for profit; the e-business ecosystem is unhealthy.

• Impact on human health. The change of e-business ecosystem can affect human health. Human health is a good indicator to measure e-business ecosystem health. A healthy e-business ecosystem should have the ability to sustain human health.

Due to the openness and complexity of e-business ecosystem, the above aspects are difficult to be summed up as a unified indicator. Measuring the indicators is a complicated and costly job, so the evaluation can focus on the most important three aspects: vigor, organization and resilience.

As a kind of indicator species method, e-business diversity index can reflect the vigor, organization and resilience of the system to some extent. When e-business diversity index is larger, it represent that more participants participate in the ecosystem. This can promote the development of productivity, and improve system vigor. Meanwhile, more participants can result in diversity and complexity of the organization. As to resilience, more participants means the entire system will not be wiped out in one crisis. The ecosystem can recover from the external stress as soon as possible. In short, e-business diversity index can be used as a method of e-business ecosystem health assessment. In addition to this, the biological integrity index also can make e-business ecosystem health assessment.

3.2 Health assessment of e-business diversity index

E-business diversity refers to the complexity and the evenness of the e-business enterprises in an e-business ecosystem. Various e-business enterprises are in one e-business ecosystem. The more diversity and evenness an e-business ecosystem has, the more competition a market would have. It can result in survival of the fittest and the ecosystem will become healthy and stable.

To calculate e-business diversity index, we must first determine the indicator species. The diversity of indicator species can indicate the diversity of the entire e-business ecosystem. The organizations, development tendency, band productivity of the core e-business enterprises, have a direct impact on the input-output of other populations. The core e-business enterprises can represent the development of the entire e-business ecosystem. Then the leadership species can be used as an upper-level e-business ecosystem's indicator species. It should show the diversity and evenness of the core e-business enterprises in one e-business ecosystem.

In low-level e-business ecosystem, the key populations can be used as indicator species for that there is only one core e-business enterprises .The diversity index should show the diversity and evenness of suppliers, producers, retailers and consumers in the ecosystem.

Take upper-level e-business ecosystem for example. The various core e-business enterprises represent complexity of ecosystem. And their market shares represent evenness of ecosystem. Use *Shannon-Weiner* index for reference .The equation of e-business ecosystem diversity index is:

$$H= -\sum P_i \cdot (log_2 P_i) \tag{1}$$

H= the e-business diversity index.

P_i=the market share of i'th core e-business businesses.

Since too many core e-business enterprises are in an e-business ecosystem, it's difficult to count all market share data. Then we can select several major e-business enterprises with larger market share to measure e-business diversity index. Equation (1) can be deformed as follows:

$$H = \frac{-\sum P_i \, g(\log_2 P_i)}{\sum P_i} \tag{2}$$

H, P_i Ibid; ΣP_i is the total market share of the several major e-business enterprises.

In order to easy to make e-business ecosystem health assessment, e-business ecosystem health can be divided into the following five levels as shown in Table 1.

Table 1.   E-business diversity index and health level

E-Business Diversity Index	Health level	E-Business Diversity Index	Health level
0～1	Pathosis	2.3～3.3	Healthy
1～1.6	Unhealthy	More than3.3	Very healthy
1.6～2.3	Alert		

E-business diversity index describes the complexity and evenness of e-business enterprises in the system. When each e-business business has the same market share, supposed that the dividing lines are respectively with 2, 3, 5 and 10 major e-business enterprises. Then the health level can be calculated.

3.3 Health assessment of e-business integrity index

Biological integrity was firstly put forward by Karr in 1981[6]. Biological integrity means the ability to support and maintain the appropriate stability of species composition, diversity and function .It is the results of a long period evolution.

E-business integrity index can reflect the comprehensive situation of the e-business ecosystem with many parameters. A single parameter cannot accurately reflect the situation of e-business ecosystem health. Then the above eight indicators should be all included in e-business integrity index.

Firstly, define the leadership population as indicator species [7-10]. Then five steps should be taken in the establishment of integrity index.

• Samples collection. Use quantitative or semi-quantitative methods to acquire leadership population samples.

• Propose candidate parameters. The above eight indicators can be used as candidate parameters.

• Parameter screening. Find relevant parameters through relationship analysis and combine them into one parameter. Make sure that each parameter is sensitive to the changes of ecological processes.

• Unify the dimension. Scoring method is commonly used, such as 3-point scale method. According to the importance, we can value the parameter 0, 3or 6.

• Test and verify the index. The value of e-business integrity index is the accumulated value of each component parameter score. The health situation of the e-business ecosystem can be concluded by analyzing the level of e-business integrity index

Although e-business integrity index also uses the indicator species method, it includes eight aspects of e-business ecosystem health assessment and it is more comprehensive. However, it is too costly to collect all the information.

4. CASE ANALYSIS

Take B2B e-business ecosystem as example (In China). The market share of major e-business in the first half of 2011 and 2002 is investigated as shown in Table 2. Make use of e-business diversity index to analyze the health situation of this B2B e-business ecosystem.

Table 2.   E-business enterprise market share

Year	the first half of 2011		the first half of 2012	
Market	Alibaba.com 52.8%	Globalmarket.com 2.1%	Alibaba.com 41.50%	Globalmarket.com 1.7%

share	Globalsources.com 9.2%	Mysteel.com 1.7%	Globalsources.com 10.30%	Corp.netsun.com 1.3%
(P_i)	Hc360.com 5.3%	315.com.cn 1.5%	Mysteel.com 4.4%	Dhgate.com 0.9%
	Made-in-china.com 3.8%	Dhgate.com 1.2%	Hc360.com 3.8%	Other 32.9%
	Corp.netsun.com 2.4%	Other 20%	Made-in-china.com 3.2%	

According to the data above, e-business diversity index can be calculated by equation (2)

$$H_{2011} = \frac{-\sum P_i \, \mathrm{g}(\log_2 P_i)}{\sum P_i} \approx 2.151$$

$$H_{2012} = \frac{-\sum P_i \, \mathrm{g}(\log_2 P_i)}{\sum P_i} \approx 2.449$$

From the results, we can reach the following conclusion:

E-business ecosystem is on the state of alert but near health in the first half of 2011. Mainly because of that Alibaba owns more than a half market shares. It has been belong to the state of health in the first half of 2012. Alibaba's market shares declined, and market shares of other e-business enterprise increased obviously. This suggests that more e-business enterprises of leadership populations participate in the market competition. The e-business diversity improved. It is benefit for the development of the whole e-business ecosystems.

E-business diversity of low-level E-business ecosystems can be got similarly with the kind of supplier, provider, retailer and consumer and their market share.

5. CONCLUSIONS

Indicator species are used in e-business diversity index and integrity index. It is hard to show a clear change on e-business ecosystem with the change of one sensitive species. A healthy e-business ecosystem based on leadership population is one-sided. The healthy e-business ecosystem we calculated is just a suitable ecosystem for core e-business enterprise. Other populations don't make direct contributions to the index. They just make influence on leadership population indirectly. However, it is difficult to achieve all the information. As a result, the models need to be further perfected.

E-business ecosystem health and its evaluation is a development and evolution process. The theory and method is not mature, and a lot of problems remain to be further researched. For example, the evaluation method remains to be improved, and the health-level is not objective. A healthy and stable e-business ecosystem is important for enterprise survival. It should be paid enough attention on keeping e-business ecosystem healthy and promoting the virtuous cycle of e-business ecological system.

In the future study, we need further analyze the factors that influence e-business ecosystem health, find out the specific indicators of e-business ecosystem health assessment and perfect models. The purpose of our research is to help e-business enterprise develop smoothly.

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