

# RESEARCH ON THE ECOLOGICAL CORRELATION ANALYSIS BETWEEN THE ENTERPRISES IN THE LOGISTICS PARK

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Abstract: This paper innovatively introduces the correlation analysis in the theory of ecosystem into the relationship analysis between the enterprises in the logistics park and has opened up a new brand-path to describe the complicated relationships between the enterprises. Through constructing a correlation analysis model, we can measure the reasonability of the enterprises distribution and understand the enterprise's core business and the integration of resources within the park more systematically and effectively, and also provide new ideas and new methods to guide the building of ecological logistics park in the future.

## 1 INTRODUCTION

Recently, the Brocade IT Logistics Supply Chain Management Research Center released the logistics research report of the second quarter in 2009, in which the statistical data of the logistics park are striking. Compared with the same period of last year, the construction rate of logistics park that has been started increases by 14 percent, while the idle rate of the logistics park has dropped to 60 percent dramatically at the same time. The direct market customers of the park or the other major enterprises attracted to the park include the transportation enterprises, logistics service providers and logistics-intensive industrial and commercial enterprises. These enterprises and entities can be divided into eight categories, including logistics enterprises, freight forwarding enterprises, commercial enterprises, manufacturing enterprises, transportation enterprises, courier enterprises, banks and other service agencies and others. However, from the perspective of the operation of our national logistics parks, the largest proportion of the enterprises settled down in the park is the logistics-intensive commercial enterprises and it has reached 50 percent, while the proportions of other enterprises

that are closely related to the logistics, such as the logistics enterprises, freight forwarding enterprises, transportation enterprises, and courier enterprises are relatively very small. The majority of main business income of many logistics parks comes from the following four aspects, including the warehouse and yard rent, facilities rent and management fees, property management fees and office building rent. Only a handful of logistics parks can make profit from the value-added services, such as the logistics information services, warehousing and distribution, etc. Even more puzzling, there are a few logistics park's profits come from the state funding, tax incentives and land rent or sales after revaluation. In short, the structure of China's logistics park system is irrational, and there is no relationships between the enterprises that only operate for their own business, or loosely connected. And there is even redundant construction, waste of resources, vicious competition between the enterprises due to homogenization, and other issues that obstruct the sound development of the logistics park seriously.

In order to describe and analyze these issues more effectively, this paper innovatively introduces the correlation analysis in the theory of ecosystem into the relationship analysis between the enterprises

in the logistics park based on the ecological characteristics of the logistics park and uses the mathematical method to measure the reasonability of the enterprise distribution within the park quantitatively and systematically, and thus to understand the enterprise's core business and the integration of resources more effectively.

## 2 ECOLOGICAL CHARACTERISTICS OF THE LOGISTICS PARK

The differences in the possession of resources on core business between the enterprises and reasonable convergence of business processes are the foundation of stable development for the whole logistics park. The differentiation of core business between the enterprises is the prerequisite of the stability of the park, since that there is often fierce competition for resources after the introduction of some enterprises with similar business, and also lead to the exit and migration of some enterprises. At the same time, the reasonable convergence of business processes is the guarantee of coordinated operation of the park, because that it requires the cooperation of many enterprises and entities to fulfill a complete logistics process, such as the various specific steps from the entrance, warehousing, distribution, delivery, out of the park to transport, as well as the integration of services, power, policy, management and other related facilities. As to these two aspects, one is the vertical possession of resource, and the other is the horizontal integration of information flow, capital flow and logistics flow. They built up a complex and stable operational system together.

We can find that there is a special similarity between the logistics park and the ecological system by comparison. For example, the difference of resource possession for the enterprise is similar to the difference of niche for the biology, and the business process is similar to the food chain. Therefore, we can consider the logistics park as an ecosystem and consider every kind of enterprises in the park as one kind of species in the ecosystem. For example, the warehousing enterprises, transportation enterprises, semi finished products processing enterprises and service enterprises are all the species in the system. The enterprises have to find their own niche if they want to maintain stability and promote their own development, otherwise there will be vicious competition between the enterprises, which just like the niche overlap between the species. We

have to build a reasonable food chain, or namely the business cooperation process on the basis of suitable niche, otherwise there would be the food chain fracture and lead to the withdrawal of enterprises and even the collapse of the whole system.

The ecological regions of the logistics park refer to the three-dimensional location of time, space and market and the functional position of the market. The enterprise's occupation to the niche can be called the separation and coexistence relationship of niche, that is to say, the noncompetitive relationship between the enterprises for the resources on the basis of proximity and separation of the enterprises' niche, and all these different niche possessions of the enterprises constitute the entire possession of internal resources in the logistics park. In this paper, this kind of extent and intensity for the possession of such resources can be measured through the correlation degree between the enterprises' niches in the park. Specifically, this paper considers all the functions and services involved in the logistics park as the total resources of the whole park, and every enterprise within the park occupies a part of the total resources. If the collection of all the enterprises' possessions of resources equals to the total resources of the park, then we can say that the system structure of this logistics park is reasonable and efficient; otherwise, according to the correlation analysis, we can understand the ecology degree of the logistics park more clearly and thus make adjustments to the logistics park accordingly.

## 3 ECOLOGICAL CORRELATION ANALYSIS MODEL

This paper constructs the correlation analysis model between the enterprises within the logistics park based on the theory of food chain among biological communities in ecology.

### 3.1 Calculation Formula of Correlation

The biological communities' correlation refers to the measurement to the correlation between the species in a biological community. It equals to the ratio of the actual food chain number observed in the communities' food net to the largest food chain number, shown as the following:

$$C = \frac{L}{S(S-1)/2} \quad (1)$$

Here,  $C$  refers to the correlation between the biological communities, which is also the correlation between the enterprises in the logistics park;  $S$  refers to the richness of species, which is also the potential richness of the correlation between the enterprises in the park, that is to say the saturated state of the correlation;  $L$  refers to the actual observed number of food chain contained in the food net, which is also the real correlation between the enterprises within the park.

The parameters of the ecological correlation between the enterprises within the park can be divided into the following categories:

$C = 1$ , shows that the correlation has reached saturation, and this is also the ideal operation state of the logistics park.

$0.5 < C < 1$ , shows that the correlation between the enterprises within the park has reached a certain rate, and this is also a good operation state of the logistics park.

$C < 0.5$ , shows that there is a serious lack of coordination in the possession and utilization of resources between the enterprises in the internal logistics park. There are relationships of overlap, cross-ties and mutually inclusive between the enterprises' niches, and these relationships will directly lead to unreasonable competition between the enterprises in the logistics park. The business was chaotic and this is the most unsatisfactory operation state and need to improve.

### 3.2 Parameters Solving Method

In order to get the parameters in the above formula, we can use a chart or matrix to demonstrate the relationships between the enterprises. When there is a small number of species and the relationships between the enterprises are simple, we can draw the connection diagram. In order to facilitate understanding, we have adopted the chart for analysis. Figure 1 explains the real biological communities' correlation between the enterprises in the logistics park which is marked with solid lines, while the dotted lines indicate the potential correlation between all the enterprises within the park.

Here, the connection between two points indicates that there is complementary and

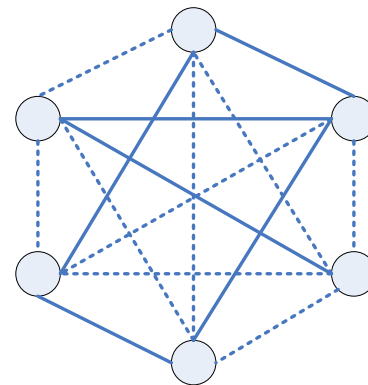


Figure 1: The correlation between the enterprises in the logistics park.

interdependent relationship between the enterprises, rather than competitive relationship. There is no doubt that it is an ideal situation when there are complementary relationships between the core businesses of all the enterprises. It shows that there is business relevance with others for every enterprise in the park, and there is no competitive relationship on the business. The species richness in Figure 1 is  $S = 6$ . The number '1' in the matrix indicates that there are complementary relationship between the enterprises in the park; while if there is no relationship between two enterprises, we will use the number '0'. Thus, the food chain of this matrix for Figure 1 is  $L = 6$ .

## 4 APPLICATIONS

### 4.1 Model Calculation

We take a logistics park that engaged in the international goods trade to apply the model. In order to simplify the calculation process, we intercept a particular logistics process of certain goods exports to carry out the application. There are six entities in this process (including the enterprises and administrative departments), and the specific process is as follows: the foreign trade enterprise  $d$  purchase a batch of merchandise for export sales from the manufacturing enterprise  $a$ , and it also contacts with the warehousing enterprise  $b$  to provide it storage and short-distance transport services, and  $b$  and  $d$  have to go to the administrative department  $f$  to deal with the relevant export procedures. The manufacturing enterprise  $a$  has to contact with the deep-processing enterprise  $e$  to segment and package the goods

before export, and then transfer to the ocean shipping enterprise *c* that engaged in the international goods transport and take goods from the warehouse of warehousing enterprise *b* and complete the entire process that the goods in the logistics park.

We use different letters *a, b, c, d, e, f* to represent all the enterprises with different core business, and then draw the diagram shown as Figure 2.

It is inconvenient to demonstrate with diagrams when there are too many enterprise species in the park, and then we can use the matrix, shown as Figure 3. The top of the matrix indicates the enterprises that need the service resources, and the left of the matrix indicates the enterprises that provide the service resources. The richness of the enterprise species in this application is  $S = 6$ . The number '1' in the matrix indicates that there are complementary relationship between the enterprises in the park; while if there is no relationship between two enterprises, we use the number '0'. Thus, for this application, the food chain of this matrix is  $L = 7$ .

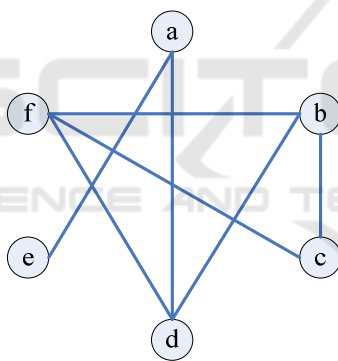


Figure 2(a)

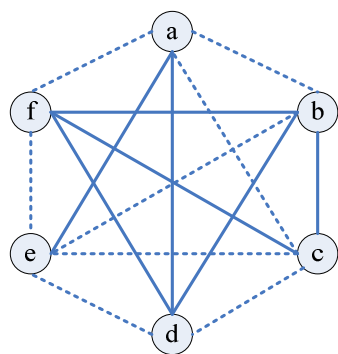


Figure 2(b)

Figure 2: The real correlation and the potential correlation.

<i>A</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
<i>a</i>	-	0	0	1	1	0
<i>b</i>	0	-	1	1	0	1
<i>c</i>	0	1	-	0	0	1
<i>d</i>	1	1	0	-	0	1
<i>e</i>	1	0	0	0	-	0
<i>f</i>	0	1	1	1	0	-

Figure 3: The correlation matrix between the enterprises in the logistics park.

The potential correlation within the logistics park is  $\frac{S(S-1)}{2} = \frac{6(6-1)}{2} = 15$ . Take  $L = 7$  and  $S = 6$  into (1) and then we can get the ecological correlation between the enterprises of this logistics park.

$$C = \frac{L}{\frac{S(S-1)}{2}} = \frac{7}{\frac{6(6-1)}{2}} \approx 0.47$$

### 4.2 Result Analysis

According to the result  $C \approx 0.47$ , we can consider that the correlation between the enterprises in this logistics park is relatively very weak. From the perspective of Figure 2, the enterprise *e* in this park is the weakest one, which has only one business relationship with enterprise *a*. That is to say, it can only provide services for enterprise *a* in the whole park and this is unreasonable for the ecological logistics park. On the one hand, the enterprise *e* has to provide service for enterprise *a*, but also only this one enterprise; on the other hand, the resources of enterprise *e* are not fully utilized, while the other enterprises don't need the service of enterprise *e* or to provide it services. So the enterprise *e* has to find a way out and exit the park to develop and pursue other interests, or to engage in other completely irrelevant business in order to seek to survive, but this will inevitably lead to the food chain fracture of the logistics park. There is only operational complementary relationship between the enterprise *a* and *c* with the other two enterprises, while the enterprise *b*, *d* and *f* also have only achieved operational complementary relationships with the other three enterprises. This kind of network relationships with mutually use of resources or the complementary relationships between the enterprises business is still very inadequate.

Here, we consider the relationship between the enterprise  $a$  and  $e$  as the relationship between two different niches. That is to say, their businesses are not overlapping in this logistics park, and there is a collection of niche space due to the logistics in this ecological logistics park. Both of from the enterprise  $a$  to  $e$  and from the enterprise  $e$  to  $a$  are the possessions of different niches. We can assume that the total number of niche correlation in this logistics park is  $N = S * 6 = 30$  based on Figure 2 (equal to the number of species in the park multiply with the total number of connections with the other enterprise species). From Figure 2, we can get the specific niche correlation that has been used in the logistics park, which is represented as  $M$ . So there are  $M = 2 * 7 = 14$  niche correlations. The number of specific ecological niche correlation of Figure 2 is shown as Table 1.

According to Table 1, we can calculate the occupation rate of the internal enterprises to the niche in the logistics park, and this rate equals to the real niche correlation occupied by the enterprise species to the total correlation under the saturated state. They are shown as the following.

$$\begin{aligned} a &= 2/30 \approx 0.067 \\ b &= 3/30 = 0.1 \\ c &= 2/30 \approx 0.067 \\ d &= 3/30 = 0.1 \\ e &= 1/30 \approx 0.033 \\ f &= 3/30 = 0.1 \end{aligned}$$

The total rate is just  $C \approx 0.47$ .

Table 1: The distribution of the enterprise niche correlation within the logistics park.

Enterprises	$a$	$b$	$c$	$d$	$e$	$f$	Number
Real enterprise niche correlation in practice ( $M$ )	2	3	2	3	1	3	14
Ideal enterprise niche correlation under the saturated state ( $N$ )	5	5	5	5	5	5	30

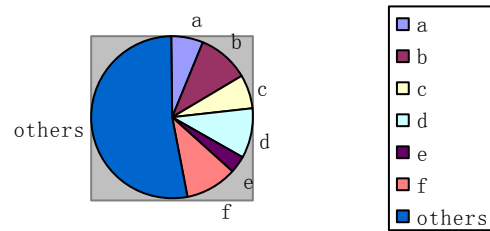


Figure 4: The pie chart of the enterprise niche occupation within the logistics park.

In order to facilitate understanding, we use a pie chart to demonstrate the distribution proportion of the enterprise species in this logistics park and the niche resources that they occupied, shown as Figure 4.

In Figure 4, the region of ‘others’ indicates that there are niches that have not been occupied and used by the enterprises in this logistics park, and the park has to borrow related businesses and functions from other areas to cover this vacancy of core business. However, it will result in two disadvantages in this way. On the one hand, it will affect the realization of economic effects in the park because of its own imperfect core business within the park and has to use other non-park enterprises to compensate for this part of the vacancies. On the other hand, it will also result in waste of resources due to the inefficient utilization of the facilities and equipments within the park. It is clear that the vacancy rate of this park is very serious, and the degree of ecology is not enough. There is still a long way to meet the requirements of ecological logistics park through the analysis.

According to the correlation analysis and combined with Figure 4, we can draw such a conclusion that there are the following five issues in this logistics park:

(1) It lacks of complementarities between the enterprises within the park and there is not a reasonable planning to introduce enterprises into the park.

(2) The efficiency of the resource utilization is not high, and there is the phenomenon of resource idle and waste.

(3) The ecology degree of this park is not enough, and it has not realized the real sense of core business integration between the logistics-related enterprises.

(4) There are enterprises whose core business is not logistics-related, such as some commercial enterprises.

The existence of these irrational issues affects the normal business dealings directly within the logistics park and often results in some unnecessary



phenomenon, such as the operation confusion, disordered competition and so on, and thus lost the original purpose of building the logistics park, as well as the role to promote the development of the logistics industry that it should take on and play.

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## 5 CONCLUSIONS

This paper introduces the correlation analysis in the theory of ecosystem into the relationship analysis between the enterprises in the logistics park innovatively and has opened up a new brand-path to describe the complicated relationships between the enterprises. It measures the enterprise correlation quantitatively through constructing the correlation analysis model and targets specific issues in the park. However, since this method is constructed based on some simplified assumptions and it just uses the binary parameters to describe the relationships between the enterprises, we can make the parameters more complicated in the future research in order to describe the logistics park more realistically.

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