Research on Low Carbon Coordinated Development of Regional Logistics Industry in Jing-Jin-Ji based on DEA Method

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Abstract

With the further development of Jing-jin-ji economy, only by reducing the carbon emissions of the logistics industry and reducing the total energy consumption, can we achieve the goal of sustainable development. In this paper, the authors anlyze the low carbon coordinated development of regional logistics industry in Jing-Jin-Ji based on DEA method. It can be seen that the concept of administrative division in Beijing, Tianjin and Hebei is strong, and the three regions pay too much attention to their own interests, ignore the overall optimization of logistics, and hinder the development of low-carbon logistics. On this basis, the author carries on the analysis of regional logistics efficiency and puts forward relevant suggestions.

Keywords: Low carbon Logistics, Traffic integration, Logistics cooperation, Synergetic development

1. INTRODUCTION

The coordinated development of Beijing, Tianjin and Hebei is a national development strategy. After the development of the Yangtze River Delta and the Pearl River Delta region, China's economic growth rate is third. Beijing is the capital of our country and the important logistics node city, Tianjin is an important port city in China and Bohai, Hebei Province, North China industrial base and regions have the advantages of traffic, the region can promote economic development China. The key advantage of Beijing Tianjin Hebei region is higher logistics operation ability, but the logistics industry is a big consumer of energy consumption and carbon emissions, and the carbon emissions of logistics industry account for a large proportion of total carbon emissions. Therefore, it is necessary to promote the development of low-carbon logistics, that is, "green logistics". Low carbon means lower greenhouse gas emissions. Low carbon logistics is an important part of the development of low-carbon economy, it advocates sustainable economic development, and make full use of logistics resources. Low carbon logistics includes low carbon transportation, low carbon storage, low carbon packaging, low carbon circulation processing, low carbon distribution and other logistics links, involving all aspects of the logistics. Provides business and manufacturing industry logistics industry has very important support and assistance, logistics in western developed countries is no longer a industrial and commercial enterprises, the operating activities, usually from the external logistics services of professional institutions, namely the Regional logistics supplier in procurement (Beasley, 1993; Elten, 2010). Although there are a few companies still retain some of the logistics operation and management functions, but more and more companies began to use Regional logistics services to supplement their own operations (Jiang, 2011; Freixo, 2014). Regional logistics is an important development direction of traditional storage and transportation enterprises (Liu, 2004; Wen, 2008). Many famous multinational manufacturing enterprises not only outsource their logistics operations to the Regional logistics enterprises, but also form a strategic alliance with them. Pragmatic and effective Regional logistics activities in improving the core competitiveness of enterprises, the level of value-added services at the same time, reduce the cost of logistics consumption, optimizing internal and external resources such as various aspects plays an irreplaceable role (Mitra, 2008; Li, 2011). With the acceleration of economic globalization and information process, the competition among countries is becoming more and fiercer. China's modern logistics industry has transformed into a new economic growth point and a very important industry in China's economic development.

Although the Regional logistics industry in our country is very rapid development, but due to the relatively backward, so it is not perfect and standard. According to the research on the logistics market demand and operation results in our country, now stage of China's Regional logistics enterprise service level is relatively low, the customer satisfaction degree is not high; resulting in development level is still relatively backward (Selviaridis, 2007; Ren, 2013). How to change this predicament, become an urgent problem to be solved. So if the Regional logistics enterprises can as soon as possible to find the existence of their own problems in a timely manner to compensate its shortcomings, a comprehensive analysis of the problem the crux of the problem, as soon as possible in order to catch up with western developed countries, the level of logistics operation, each link of the supply chain for better control. Based on the Regional logistics enterprise performance evaluation can

enable enterprises to beforehand control and guidance on its performance and efficiency, ex post assessment and measurement, judge whether the completion of the scheduled tasks, due to the effectiveness (Seth, 2006). With the further development of Beijing Tianjin Hebei economy, only by attaching importance to the development of low-carbon logistics, reducing the carbon emissions of the logistics industry and reducing the total amount of high energy consumption, can the logistics and environment be harmonious and achieve the purpose of sustainable development.

2. DEVELOPMENT OF LOW CARBON LOGISTICS IN BEIJING TIANJIN HEBEI REGION

2.1. Low carbon Logistics

The concept of low carbon logistics has been put forward for many years in our country, but people still have limited understanding of low-carbon logistics. For a long time, logistics practitioners from the point of view of economic efficiency of enterprises, consider more cost, ignore low carbon environmental protection. The concept of administrative division in Beijing, Tianjin and Hebei is strong, the three regions pay too much attention to their own interests, ignore the overall optimization of logistics, and hinder the development of low-carbon logistics. Moreover, three areas lack of low-carbon logistics management policies and programs, low carbon logistics professionals less. From the current situation of Beijing Tianjin Hebei region, more logistics facilities and equipment need to be updated, and there is no carbon emission standard in the industry. In the current economic and social environment of Beijing, Tianjin and Hebei, there is a lack of atmosphere for developing low-carbon logistics. When enterprises in the promotion of low-carbon logistics, the cost control of enterprise efficiency and energy saving and emission reduction social benefits conflict, it is necessary for the national and local governments to take some measures to formulate relevant policies to support. HoFrom the total logistics industry in Beijing, Tianjin and Hebei Province, although the total logistics industry in two regions of Beijing and Tianjin is lower than that of Hebei Province, the pressure of logistics in Beijing is great. Beijing Tianjin Hebei region has not yet introduced regional logistics industry integration collaborative development planning, but also did not publish the unified planning of low-carbon development of logistics industry, three areas lack of detailed rules of logistics low-carbon.

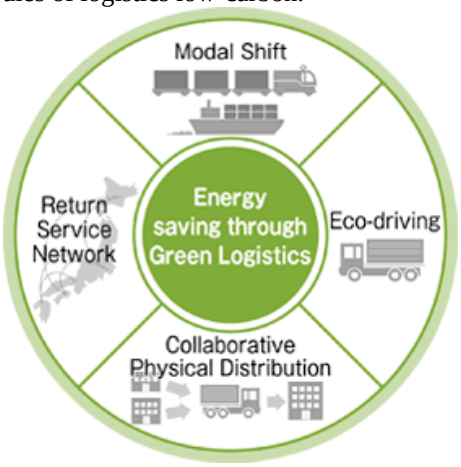

Figure 1. Low carbon Logistics

2.2.Beijing Tianjin Hebei cooperation

From the logistics standardization and informatization level of Beijing Tianjin Hebei region, Beijing is on the high side, and Tianjin and Hebei are on the low side. Because of the logistics industry in the three regions without a unified public information platform, various departments and units in the construction of information platform, and gradually formed a information island, lost the advantages of information technology, the logistics information sharing and free exchange. Improving logistics informatization is the basis of low-carbon logistics, and also is the premise of improving logistics efficiency. At present, although the low-carbon logistics technology in Beijing Tianjin Hebei region has some improvements, but it is still far from the level of developed countries. In the Beijing Tianjin Hebei region, due to the economic and technological differences in three areas, EDI, radio frequency and GPS technology in the logistics industry is not timely popularization. At the same time, due to the motor vehicle no-load rate, empty driving rate is higher, also caused a large amount of carbon dioxide emissions. Beijing Tianjin Hebei region is still in the stage of "oil to electricity" in the field of transportation; in the packaging process, the plastic material is in the paper stage, and the reuse method of the packaging is still lagging behind.

The inter city transportation structure of Beijing Tianjin Hebei Urban Agglomeration is single, and the road transportation mainly undertakes the freight transportation task, and the highway freight volume accounts

for more than 70% of the total freight volume in the whole region. In the urban areas with complex traffic conditions, the consumption of consumer groups is large, and the urban distribution network is more concentrated in this area. At present, the logistics service delivery efficiency of Beijing Tianjin Hebei is low, the scale is low, the development of joint distribution is limited, traffic congestion and energy consumption are high, resulting in higher logistics cost of the "last mile" in the city. Large consumption of distribution transportation, such as noise, dust, exhaust emissions, causing serious pollution of the urban environment. Therefore, it is necessary to gradually realize the low carbon optimization and efficiency promotion of urban distribution.

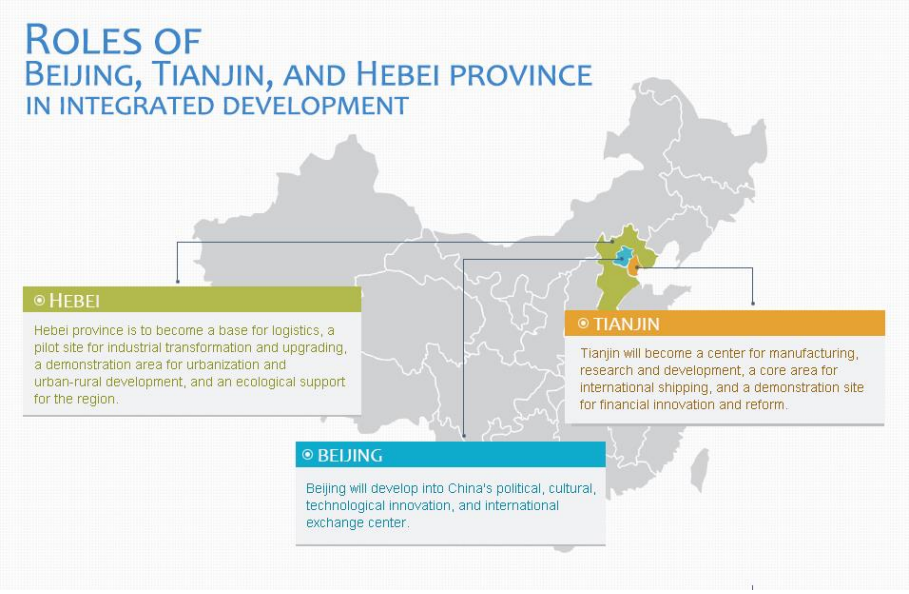

Figure 2. Beijing -Tianjin -Hebei cooperation

3. EMPIRICAL ANALYSIS

3.1. Evaluation index system

According to the research of the regional logistics development index, it is necessary to establish a kind of evaluation method, which makes the evaluation result more reasonable, scientific and accurate. Regional logistics enterprises can accord the evaluation results, the development of their own to make appropriate adjustments. In order to make the evaluation result more accurate, we should establish the principle that should be followed in the evaluation system of the Regional logistics enterprise.

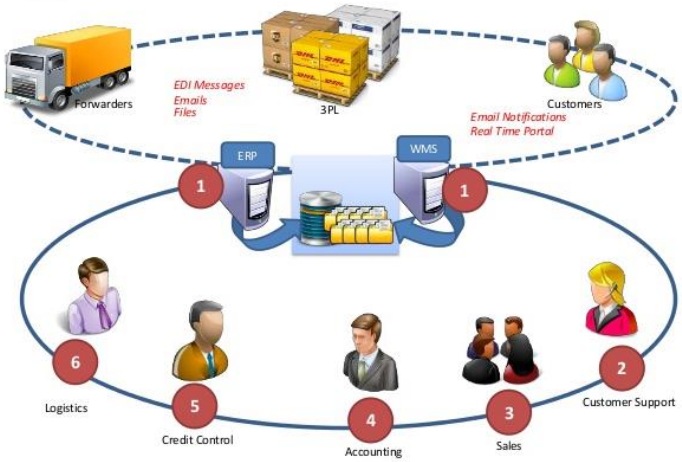

Figure 3. Logistics synergy

(1) Each index in the evaluation system should follow the principle of comparability. The spatial and temporal range of evaluation index system and the method of calculating caliber and economic content should be comparable. Therefore, the establishment of evaluation index system should refer to the international and domestic logistics management standards.

(2) In the evaluation system of the various indicators should follow the principle of universal. Evaluation index system should be widely applied in the Regional logistics enterprises, and it should have the relative stability in the development of theory and practice.

(3) Each index in the evaluation system should follow the principle of hierarchy. Each indicator should be divided into evaluation levels, in each level of the indicators selected to highlight the key, and the key performance indicators to focus on analysis.

(4) In the evaluation system of the various indicators should follow the principle of systematic. Enterprises should design the corresponding evaluation index based on the situations inside and outside of the Regional logistics enterprises, systematically, scientifically and comprehensively reflect the panorama of the Regional logistics enterprise to on the Regional logistics enterprise overall and scientific evaluation.

(5) The Regional logistics enterprise performance evaluation method should follow the principle of quantitative and qualitative combination. In the selection of indicators should be based on quantitative indicators, can be used as far as possible to use a quantitative method of quantitative calculation method; cannot use quantitative methods or not suitable for quantitative methods, the use of qualitative analysis.

(6) In the evaluation system of the various indicators should follow the principle of dynamic long-term. Because of the choice of the Regional logistics enterprises, between the supply and demand side and the Regional logistics provider will establish good strategic partner relationship, so evaluation of Regional logistics enterprises should not limited in the current state of the enterprise, and should consider the long-term development potential.

This paper establishes the logistics performance evaluation index system from four aspects of financial performance, operation process, learning innovation ability and customer relationship management. As shown in table 1:

Table 1. Performance evaluation index of logistics enterprises

First order index	weight	Second order index	weight
Financial performance	0.5891	Income status	0.1783
		Operation status	0.1652
		Debt paying ability	0.0791
		Development ability	0.0625
Operation process	0.4326	Market competitiveness	0.0593
		Logistics facilities	0.0325
		Flexible strategy	0.0894
		information sharing	0.0872
Innovation ability	0.1812	learning ability	0.0462
		Innovation ability	0.0914
Customer relationship	0.1560	Service quality	0.0346
		Service attitude	0.0298
		Client Review	0.0125

3.2. Analytical Hierarchy Process

The analytic hierarchy process was put forward by the United States atty in the last century in 70s. It is a multi objective decision analysis method which combines the qualitative and quantitative analysis. The main idea is to through the analysis of the complex system of related elements and their mutual relations, simplify the ordered hierarchical structure, these elements are incorporated into different levels, in each layer establish judgment matrix, obtains the relative weights of the elements. At last, calculate the multilayer elements for the overall goal of the combination weights, for decision-making and selection provides the basis. Although our country in the middle period of the eighties of the last century began to research to the level analysis method, but its development is very rapid, multiple fields, is now in the enterprise benefit analysis, group evaluation of the comprehensive strength, energy system analysis, urban planning, economic management, scientific research evaluation has been extensive attention and application. Because the analytic hierarchy process is simple and easy to operate, and can be used to quantify the advantages of qualitative indicators, so in the Regional logistics enterprises in the field of evaluation is often used, is the most common evaluation method. However, because of the combination of the analytic hierarchy process in the operation process of subjective experience, so it is inevitable that it is inevitable, the need to combine with other methods to eliminate this subjective influence. Using AHP to determine the weight of each evaluation index, under normal circumstances, according to the following steps:

(1) To establish a mathematical model with hierarchical structure, to analyze the relationship between the various factors in the evaluation index system, so as to establish the hierarchical structure of the system. That is

to say, the evaluation object carries on the analytic hierarchy process, first from the target layer, then to the criterion layer, finally to the sub criterion layer, so as to determine the clear index evaluation system, and give the evaluation object factor set and sub factor set.

(2) Structure and the formation of a comparative judgment matrix, the same level of each element, based on the importance of a certain level of 22 comparison, the structure of the 22 comparison judgment matrix. By experts in the use of 1-9 ratio scale method respectively for each level of evaluation index of relative importance were the corresponding qualitative description; and accurate digital quantization representation, ultimately determine the pairwise comparison judgment matrix.

Factors set Z in each of the factors relative to the overall evaluation of the target, compared to 22, and thus the formation of the judgment matrix is as follows:

$$Z=\begin{bmatrix} 1 & Z_{12} & \cdots & Z_{1m} \\ Z_{21} & 1 & \cdots & Z_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ Z_{m1} & Z_{m1} & \cdots & 1 \end{bmatrix}$$

The judgment matrix is as follows:

$$B=\begin{bmatrix} 1 & g_{12} & \cdots & g_{1m} \\ g_{21} & 1 & \cdots & g_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ g_{m1} & g_{m2} & \cdots & 1 \end{bmatrix}$$

The relative weights of elements are calculated according to the judgment matrix, and each column of the judgment matrix is normalized;

$$\overline{z_{ij}}=\frac{z_{ij}}{\sum_{k=1}^{n} b_{kj}}$$

After each column is normalized, the judgment matrix is obtained, and then the matrix is summed up:

$$\overline{H_i}=\sum_{j=1}^{n}\overline{b_{ij}}$$

The calculation of Max according to the following formula:

$$\lambda_{\max}=\sum_{i=1}^{n}\frac{(Ah)_i}{nh_i}$$

Calculate the combined weight vector, and then do a combination of consistency test. Calculate the synthesis weights of each layer of elements on the system target, and sort according to the consistency index to test the combination consistency.

$$C.I.=\frac{\lambda_{\max}-n}{n-1}$$

Table 2 . R.I. value of judgment matrix

1	2	3	4	5	6	7	8	9
0.00	0.00	0.57	0.82	1.14	1.31	1.40	1.42	1.47

Calculate the consistency ratio C.R.

$$C.R.=\frac{C.I.}{R.I.}$$

3.3. Performance evaluation of logistics enterprises

In order to further illustrate the practicality of AHP evaluation model, this paper selects third 8 party logistics enterprises as the research object, and collects the relevant data of the relevant performance indicators. According to the evaluation model designed in this paper, using SPSS as the calculation tool, the logistics performance of the enterprise is sorted. The Regional logistics enterprise performance evaluation system is divided into four levels, then use AHP analysis to each of the two indicators for pairwise comparison, and use Yaahp software for complex data processing, finally get the following judgment matrix, as shown in Table 3.

Table 3. Judgment matrix of first order index

First order index	Financial performance	Operation process	Innovation ability	Customer relationship	weight
Financial performance	1	3	6	2	0.5285
Operation process	1/3	1	5	1/3	0.2476
Innovation ability	1/6	1/5	1	1/7	0.1513
Customer relationship	1/2	3	7	1	0.1024

The above data reflects the consistency of the judgment matrix is acceptable, and then calculated to get the weight of the first class indicators:

$$a=(a_1,a_2,a_3,a_4)=(0.5285,0.2476,0.1513,0.1024)$$

The correlation matrix of each layer index can be obtained by strict standard calculation of the original data in the sample. By calculating the characteristic value of U and its corresponding orthogonal normalized vector, the number of the principal components of the model is 4, which is very clear.

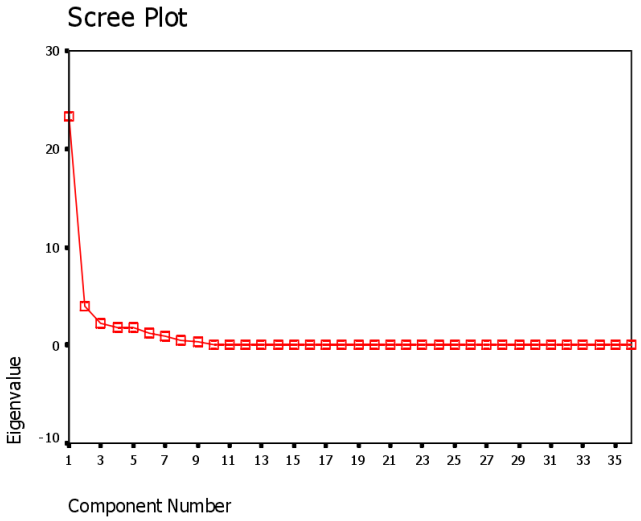

Figure 4. Scree plot

According to table 4 can be obtained by principal components could explain the total variance of the original variables situation (characteristic value, the contribution rate of variance, cumulative variance contribution rate) and the fifth column to the seventh column is the initial solution according to a certain standard extract the four principal components from the overall description of the primitive variables, they reflect the most information of the original variables.

Table 4. Explanatory variables

	initial value			**Extract value**			**Rotation value**		
component	characteristic value	Variance contribution rate	Cumulative	characteristic value	Variance contribution rate	Cumulative	characteristic value	Variance contribution rate	Cumulative
1	24.142	62.316	62.316	22.142	63.186	63.186	8.254	25.145	25.145
2	3.876	15.451	77.827	3.742	12.561	75.747	8.106	22.131	47.276
3	2.352	6.665	83.672	2.356	6.265	82.372	8.248	21.042	67.318
4	1.794	5.242	88.68	1.791	5.142	87.514	5.637	14.169	81.487
5	1.461	4.587	92.461						
6	1.146	3.325	95.867						
7	.928	2.541	97.517						
8	.764	1.328	98.845						

Through the above analysis, the different main components can highlight the same indicator information, so the simple linear addition may be too stressed that the evaluation results are not objective. Therefore, only according to the variance contribution rate of each principal component, the weight of each index class can make the result of the Regional logistics enterprise performance evaluation more scientific and reasonable.

4. COUNTERMEASURES OF DEVELOPING LOW CARBON LOGISTICS

4.1.Policy guidance for low carbon Logistics

To develop and develop the low-carbon logistics in Beijing, Tianjin and Hebei, the government departments of the three areas should work together to formulate low-carbon logistics development strategy, introduce relevant policies and formulate relevant laws and regulations. Three regional government reform and Development Commission should take the lead in establishing the logistics cooperation mechanism in Beijing Tianjin Hebei region, and do a good job of coordination between the three areas of the relevant industry departments, and truly play a leading role in the government. The logistics industry is a large carbon emission company. It is necessary to strengthen the investigation, prediction and analysis of logistics industry, do a good job in logistics statistics, and establish a scientific index system of logistics statistics. Therefore, in Beijing, Tianjin and Hebei region should try to establish a set of testing and evaluation system, namely carbon index system. The logistics, transportation, warehousing, wholesale, retail and postal consumption should be calculated, and the carbon emissions of the entire logistics industry should be counted to determine the control indicators of carbon emissions in the logistics industry. By the Beijing, Tianjin and three regional development and Reform Commission, responsible for the formulation of low carbon logistics indicators. Each logistics enterprise reports the carbon index plan to the logistics industry association at a certain time, plans the emission reduction and low carbon development plan of the logistics main body, lists the emission reduction details. The Logistics Association and the development and Reform Commission carried out the measurement to determine the emission reduction tasks of the logistics enterprises. The government should determine carbon emission reduction according to carbon index, formulate carbon tax policy, and use carbon tax to curb carbon emissions. China's carbon tax issue has been discussed for a long time, but the national development and Reform Commission, the Ministry of Finance and the Ministry of environmental protection of the three parties have not yet issued a unified standard, hoping to use the coordinated development of Beijing, Tianjin and Hebei, the implementation of carbon tax.

4.2.Promote transportation integration

Beijing Tianjin Hebei region nedd establish and improve the logistics channel, first of all, traffic integration as the leading field. as build a comprehensive transportation network interconnection, and accompanied by high-speed, fast, timeliness, security, high-capacity, low-cost role. To organize and implement good Tianjin existing transportation, highway, railway, air, improve water transport network, to complete the road three area connection, to borrow the Beijing Tianjin Hebei Road connect and integration opportunities, promote the integration of transportation. It is necessary to establish a unified public information platform for the logistics industry in Beijing Tianjin Hebei region, so as to share and exchange logistics information freely.

The total area of Beijing, Tianjin and Hebei is more than 210 thousand square kilometers. Combined with the factors such as speed, capacity and cost, the highway and railway intermodal transportation of freight transport is promoted. Railway transportation or sea transportation should be the main way to reduce highway transportation. Three, the logistics service control policy should be liberalized and coordinated multimodal transport be coordinated. The establishment of intelligent transportation system, improve the traffic congestion, the road network traffic flow in the best state, so as to reduce vehicle pollution, reduce vehicle emissions, and to control congestion and pollution.

5. CONCLUSION

Beijing Tianjin Hebei region should make reasonable planning and cooperation to ensure the construction of regional low-carbon logistics park. To co-ordinate the construction of Beijing Tianjin Hebei logistics park, to prevent duplication of investment, avoid waste, and make reasonable planning low-carbon Logistics Park construction. Beijing Tianjin Hebei three areas should co-ordinate the distribution center position, realize the specialization of distribution center, plan low carbon distribution network map, make the carbon emissions in the process of distribution to reach the minimum. Beijing Tianjin Hebei based on cross regional carbon trading to work, to the introduction of carbon trading policies, the introduction of carbon emissions trading, the formation of voluntary emissions trading market, the design of carbon emissions trading price mechanism, the logistics of carbon emissions trading system of Beijing Tianjin Hebei region. Logistics industry should make use of carbon trading market to carry out low-carbon logistics transactions.

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