The Research on the Logistics Management Mode and the Application of AHP and DEA of X Group's Chain Supermarket Under the E- commerce Environment

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Abstract

With the rapid development of science and technology, people's life style has changed greatly. Under the background of that, the electronic commerce, conforming to the historical tide, has been used by more and more businesses man and customers. At the same time, the logistics management, which was born along with the electronic commerce, makes a lot difference to social development. This article cites the theory of logistics management to establish the Grey correlation methods of analytic hierarchy process and data envelopment analysis through analyzing the chain operation enterprise. And after a comprehensive analysis from some specific examples, it also draws a conclusion that the main factors which affect the logistics management are the cost and the availability of investment, and the choice of logistics management mode is the third party logistics management model and joint distribution logistics management mode. The research of the theory points out the emphasis of the construction of logistics management, and guides the development direction of logistics management.

Keywords: E- commerce ；logistics management；Grey correlation methods; analytic hierarchy process; data envelopment analysis

1. Introduction

The core of E-commerce is the "business", and "electronic" is a means of business negotiation. The narrow sense of the E-commerce definition is the business activity which is conducted by Internet. Its generalized definition is, through the electronic tools to complete the transfer of commercial activities of the goods. It includes three main bodies: retailers, consumers and businesses, and three types of the electronic commerce system: localized electronic data exchange of e-commerce system, the Internet electronic commerce system and the electronic commerce system based on the enterprise network environment , as well as three kinds of mode: B2B, B2C, C2C . The successful development of Taobao network and Jingdong mall open a door for the prosperity of the e-commerce era. And the development of the computer has greatly promoted the arrival of the network information age. What's more, the new online payment methods provide an extensive application and development for E-commerce. And with the progress of the times, the advantages of E-commerce should be rather obvious. For instants, from a regional perspective, it has been extended from the city to towns and villages; from the degree of development, it has risen in a straight line from a slow development; from field's aspects, it has greatly changed the people's original lifestyle and the production mode from trade to logistics and storage.

In the matter of the fact, the Chain operations have three types including standard chain, free chain and franchise chain which originated in the United States and has become a commercial success mark since the nineties of last century. As a business organization, the Chain operation is a kind of unified and regular business activity to

make a single individual to a whole. Its scale efficiency, customer satisfaction, cost of the overall not only provide a great for their own enormous benefits, but also brings a huge social benefits for themselves. Chain business has its own characteristics of a unified concept, identifying consistent, unified service, and standardization management. And the distribution enjoys the characteristics of bulk purchasing, variety and large distribution fluctuation and diversified service content. The main objects of delivery are commercial chain enterprises, inter commercial chain enterprises and retail chain industry. The chain operation theory enjoys a rapid development since been introduced into our country, it has been involved all aspects of convenience stores, shopping malls and supermarkets, especially for the most successful businesses which completed the scale benefit for enterprise through it. In foreign countries, with high quality of service, advanced technology and equipment, the chain operation, take a wide market, among of that, the fastest developed one belongs to the Japan and the United states. The connection of Chain management and e-commerce, in fact, commits to the goal of three-dimensional integration which includes output, total and sales, in order to realize maximum extent protection of less transport channels, flexible and cost reduction. But there are exit some problems in chain operation, such as low degree of standardization, poor support ability of the science and technology, low level of information, logistics and distribution system, and so on. In a certain extent, all of that has limited the further development of chain retail enterprises. At the same time, our experts and scholars, in the study of distribution chain, will put chain distribution center planning, path, pattern and supply chain management into chain distribution system. Now they need improvements and developments in thought, concept and interests in a rush.

The concept of Logistics was defined by a foreign scholar from the marketing managements. It refers to physical transport in the past, but now involves the storage, transportation, processing, information input and so on. The logistics need to put market distribution, customer satisfaction, cost production and other factors in mind. Among them all, the influencing factors of logistics are cost and internal services. The main points to the Logistics design are logistics procurement and distribution, logistics competitive and pattern. The purpose of Logistics management is to realize the high distribution efficiency and quality and low costs, and finish goods management transfer by fully consideration of the costs, environment, service and internal factors. The four major performance trends of it are diversification, international connection, mechanical automation and the difference development level. Especially with the begins of electronic commerce, logistics management information systems show a prominent position, that is, to provide information technology for the whole process of logistics by the use of computer database technology.

2. The Present Situation of the Supermarket Logistics Management Mode under the Modern E-commerce Environment

Under the background of electronic commerce environment, the chain enterprise logistics management becomes more complex. Facing the situation of faster change market, fast frequency of products promotions, fast showing of the new merchandise, consumers high requirements of returning goods handling, business men need to optimize the model of logistics management and meet the demands of a new age, thus provide these logistics management model following as:

(1)Wang Hodgkin's the fourth party logistics management mode: generally, the fourth party logistics management mode is dominated by the government, which provides future planning and related information and other operation activities extensively through the collaboration operation with other businesses and enterprises, designing scheme, information integration for industry innovation point of presence. In fact, the body of the

fourth party logistics management model does not play a role in the actual conduction, it make decisions as a conductor.

(2).Supplier logistics management mode: In the supplier management mode, suppliers will put chain enterprise as the main body, and collect the trade orders from all over the world, then list the related information in the database, finally, transport the goods unified. This kind of mode enjoys following characteristics of simple operation, fast and convenient, goods transmission and distribution efficiency and the overall distribution costs reduction. At the same time, it also has the characteristics of long-term storage, large apace occupation and so on.

(3) The third party logistics management mode: third party logistics management mode, pay attention to operate the main logistics business to realize the goods transport. The model has the advantages of goods resources concentration, small area space occupation, low investment risk, cost saving, convenient transportation and so on. What's more, because it still in a period of developing without a mature theory and practice development, thus resulting in weak processing ability of logistics and existing the problem of logistics management.

(4) Self distribution logistics management mode: self distribution logistics management mode is a mode that the enterprises distribute their own goods. It has advantages of high transport efficiency, management integration and high safety factor. But it also has disadvantages of insufficient use of resource utilization, traffic congestion problem, and serious environmental pollution, etc.

(5) Common distribution logistics management mode: joint distribution logistics management mode is the logistics management mode of the common distribution of goods with the advantages of high resource utilization, convenient transportation and environmental protection and the disadvantages of poor profit and low security.

(6) Direct distribution logistics management mode: direct distribution logistics management mode is a kind of mode that refers to the home delivery services. The delivery complete logistics distribution work by appointing the delivery time and place with the receiver. Among them, personal collection container is an extension of the direct distribution model which can save delivery time and provide convenience for the recipient who doesn't have time to receive the goods. But the Fixed site needs personnel on duty.

(7) Indirect distribution logistics management mode: indirect distribution logistics managements, refers to the mode that the goods will be unified sent to a fixed place, and then, notice the consignee who take the goods directly at receiving space. This model actually transfers the form of goods transportation into a centralized delivery form. Indirect distribution can effectively solve all kinds of problems existing in the direct distribution such as high cost, low transmission efficiency and high difficulty of the task accomplishment.

This article considers the self distribution logistics management mode, the third party logistics management mode, the fourth party logistics management mode and the common distribution logistics management mode.

3. Research on Chain Supermarket Logistics Management Mode under the Environment of Electronic Commerce

The author conducts a research to the supermarket chain of logistics management according to the internal relations of management mode of chain supermarket logistics under the electronic commerce environment to avoid the man-made subjectivity and randomness and to overcome disadvantages of the data envelopment analysis method which could not fully rank the scheme in a scale. The specific relationship among with e-commerce, chain business and logistics management following as:
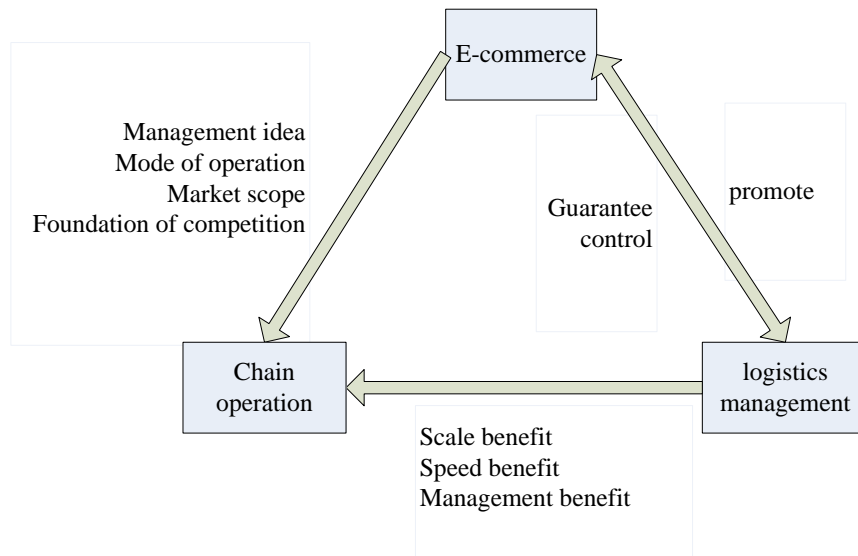
Figure 1. The relations of E-commerce Chain Management Logistics Management

3.1 The Analysis Methods of AHP and DEA

Above all refers to the grey correlation theory, which is a method that researching the correlation degree of each plan and the optimal plan. Its Operation method is very simple without any strict requirements and typical distribution principals.

(1)Analytic Hierarchy Process (shorted as AHP)

AHP is an analytical method which combines the qualitative and quantitative into the same model, with full consideration of expert advice and recommendations, it uses a certain scale to quantify the subjective judgment of experts. By converting the qualitative indicators into quantitative factors, together with other quantitative factors to build the model and sort the influencing factors, it plays an important guiding role in determining the degree of influencing factors in the process of task accomplishment. And the establishment steps of AHP analytical method following as
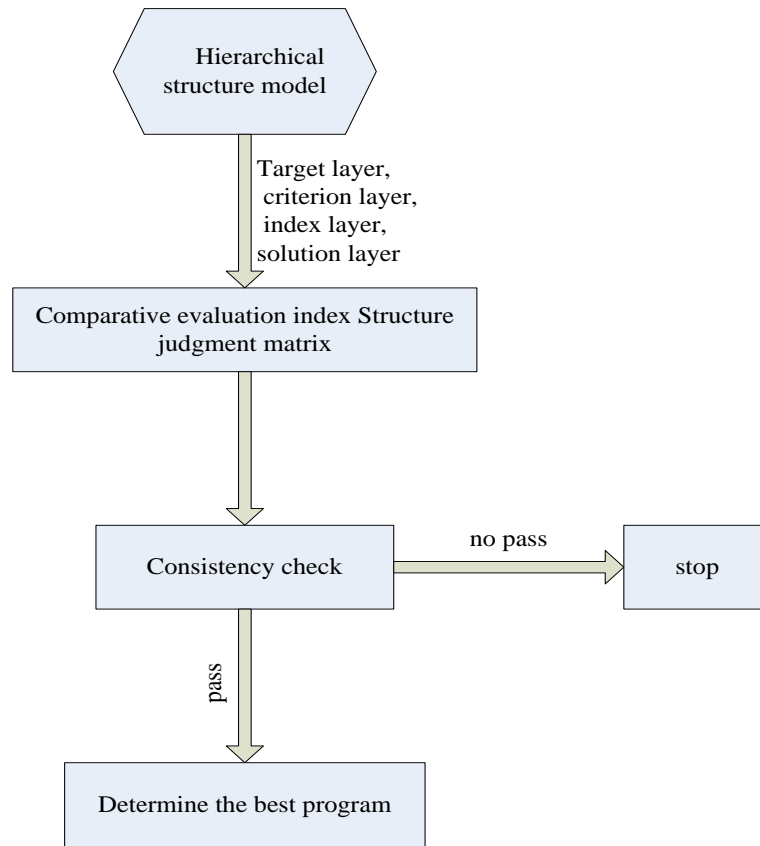
Figure 2. AHP Analytical Method Procedures

① Hierarchical structure

To determine the main influencing factors of the model, and list the main hierarchy and the second level factors

②Structure judgment matrix

Judgment matrix is the matrix of the upper level. Generally has 3 degree scale method, 1.1-1.9 scale method, 1-9 scale method. In this paper, the 1-9 scale method is used to judge the meaning of the matrix:

Table 1. The Judgment of Matrix Scale and its Implication

Scaling a_{ij}	Definition
1	Factors I and j are equally important
3	Factors I and j are less important
5	Factors I and j are a little bit important
7	Factors I and j are really important
9	Factors I and j are absolutely important
2,4,6,8	Middle scale value of above all
Reciprocal	Factor i and factor j are relatively weak, then the judgment is reciprocal.

The judgment matrix of the target layer and the main layer is as follows

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ a_{31} & a_{32} & \cdots & a_{3n} \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

The weight vector of the factors is

$$\varepsilon = \frac{\sqrt{\prod_{j=1}^{n} a_{ij}}}{\sum \sqrt{\prod_{j=1}^{n} a_{ij}}} \tag{2}$$

The weight matrix of the obtained factors is

$$\varepsilon(A) = (\varepsilon_1, \varepsilon_2, \varepsilon_3, \cdots, \varepsilon_n) \tag{3}$$

③ Consistency check

The average random consistency index RI is as follows

Table 2. The Average Random Consistency Index RI

Project	coefficient								
N	1	2	3	4	5	6	7	8	9
RI	0	0	0.42	0.85	1.11	1.26	1.35	1.48	1.51

Maximum eigenvalue:

$$\lambda = \frac{1}{n} \sum_{i=1}^{n} \frac{(A\varepsilon)_i}{\varepsilon_i} \tag{4}$$

Judgment matrix order:

$$CI = \frac{\lambda_n - n}{n - 1} \tag{5}$$

Consistency ratio:

$$CR_A = \frac{CI}{RI} \tag{6}$$

Similarly, the weight of target layer G and levels B, as shown in the following chart

Table 3. The Weight Value of Target Layer G and Levels B

	A_1	A_2	$\cdots$	A_n	weight value
	ε_1	ε_2	$\cdots$	ε_3	
B_1	q_{11}	q_{12}	$\cdots$	q_{1n}	$\sum\limits_{j=1}^{n} \varepsilon_j q_{1j}$
B_2	q_{21}	q_{22}	$\cdots$	q_{2n}	$\sum\limits_{j=1}^{n} \varepsilon_j q_{2j}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
B_n	q_{n1}	q_{n2}	$\cdots$	q_{nn}	$\sum\limits_{j=1}^{n} \varepsilon_j q_{nj}$

Consistency ratio:

$$CR_B = \frac{\sum\limits_{i}^{n} \varepsilon_i CI_i}{\sum\limits_{i}^{n} \varepsilon_i RI_i} \tag{7}$$

(2) Data Envelopment Analysis (shorted as DEA)

Based on the relative concept, DEA is a comprehensive evaluation method of multi index outputs and inputs, which is, also called efficiency evaluation method in that the relative efficiency of each index will be evaluated by mathematical programming.

The benefit level of influencing factors is expressed as

$$M = \frac{\sum Out}{\sum In} = \frac{\alpha O}{\beta I} \tag{8}$$

Among them, α is the output weight coefficient, that is, $\alpha = \left(\alpha_1, \alpha_2, \cdots, \alpha_n\right)^T$, O is the output factors, that is, $O = \left(O_1, O_2, \cdots, O_n\right)^T$, β is the input weight coefficient, that is, $\beta = \left(\beta_1, \beta_2, \cdots, \beta_n\right)^T$, I is the input factors, that is,

$$I = \left(I_1, I_2, \cdots, I_n\right)^T \tag{9}$$

(3) Dual Analysis Method

The dual analysis method is a kind of combination of AHP and DEA, which combines the two methods of the subjective preference and the most favorable index weight of each decision making unit. For qualitative factors, people often choose the AHP analytical method, which is, transferring the qualitative factors into quantitative factors. For quantitative factors, people often choose the DEA analytical method to sort the importance of factors. The specific calculation formula is as follows:

$$X_i^* = \left(\partial X + (1-\partial)X_I\right) = \left[x_1^*, x_2^*, x_3^*, \cdots, x_n^*\right]^T \tag{10}$$

3.2 The Logistics Management Mode Selection for X Group Chain Supermarket

I. The Logistics Management Mode Selection Based on the AHP

(1) Establish the hierarchy chart

Table 4. the X group's chain supermarket summary statement of considering factors

Main factors	Secondary factors	other factors
Costs	transportation cost Investment cost	Self management model
Services	reliability Available property	the third party logistics management mode
Environment	politics Economy	the forth party logistics management mode
Internal	Personnel Commodity	Common distribution logistics management mode

(2) Constructing the judgment matrix for the consistency check.

① the judgment matrix of target layer G and main layer A

Table 5. The Judgment Matrix of Target Layer and Main Layer

G-A	Cost 1	Service 1	Environment 1	Internal 1
Cost 2	1	3	7	4
Service 2	1/3	1	4	3
Environment 2	1/7	1/4	1	1/3
Internal 2	1/4	1/3	3	1

The conclusion calculated by $MATLAB$ that the maximum eigenvalue of judgment matrix G-A is $\lambda_{MAX} = 3.987$ .Then normalized the value of feature vector gets $\varepsilon(A) = (0.3689, 0.2894, 0.09856, 0.1235)^T$ consistency index is $CI_A = 0.0039$. From the distribution table RI and $CR_A = 0.0048 < 0.1$ people know that the target layer and the main layer meet the consistency test.

② the judgment matrix of main layer A and secondary layer B

The conclusion calculated by $MATLAB$ that is following as:

Table 6. Statistics Table of the Results of the Primary and Secondary Levels

A_j	A_1	A_2	A_3	A_4
B	0.0635 0.4756 0.1567 0.2584	0.6345 0.2456 0.2038	0.1114 0.0389 0.2914	0.2641 0.8912
λ_{Max}	4.5614	3.0325	0.0018	2
CI	0.0022	0.0235	0.0014	0
CR	0.0022<0.1	0.0235<0.1	0.0014<0.1	0<0.1
result	fit	fit	fit	fit

Above all, the conclusion is that target layer G and the secondary layer B meets the consistency test.

The weight coefficient of the second level B is:

$$B = (q_1, q_2, q_3, q_{4,} q_5, q_6, q_7, q_8)$$
$$= (0.0304, 0.2251, 0.0648, 0.1211, 0.0415, 0.0241, 0.0258, 0.0341)^T \qquad (11)$$

Thus, the Index weights can be sorted as investment cost, Available property, reliability, politics, commodity, personnel, transportation, cost, economy.

II. The Logistics Management Mode Selection Based on the DEA

On the basis of the analytic hierarchy process, the other factors has been analyzed by the $MaxDEA$ software model based on the analytic hierarchy process, then the weights are multiplied by the standard data which is calculated based on the DEA, equals to the data that following as:

$$
\begin{bmatrix}
0.1424 & 0.3214 & 0.1457 & 0.1457 \\
0.8547 & 0.6324 & 0.5714 & 0.2571 \\
0.4634 & 0.6324 & 0.3654 & 0.6987 \\
0.6344 & 0.2144 & 0.5476 & 0.3547 \\
0.6952 & 0.1447 & 0.5448 & 0.2237 \\
0.2441 & 0.5568 & 0.3667 & 0.3984 \\
0.2544 & 0.3647 & 0.2354 & 0.6984 \\
0.3644 & 0.5254 & 0.6364 & 0.2544 \\
0.2441 & 0.3654 & 0.3644 & 0.5874 \\
0.1127 & 0.5454 & 0.6841 & 0.5844 \\
0.2211 & 0.3641 & 0.2565 & 0.3694 \\
0.3654 & 0.2565 & 0.2544 & 0.6394
\end{bmatrix}^T
*
\begin{bmatrix}
0.3571 \\
0.3664 \\
0.3647 \\
0.7751 \\
0.2571 \\
0.1754 \\
0.5874 \\
0.3647 \\
0.6874 \\
0.5841 \\
0.5741 \\
0.3684
\end{bmatrix}
=
\begin{bmatrix}
0.3681 \\
0.6817 \\
0.3527 \\
0.5237
\end{bmatrix}
$$

Therefore, the important degree of other factors from high to low ranking: third party logistics management, logistics management, logistics distribution management, the fourth party logistics management.

4. Conclusion

Following the trend of the current situation, the enterprises fit customers' needs, market satisfaction and profit operating to obtain profits through various channels. With the rise of E-commerce, a series of production or activity has been greatly boosted. This article takes x group supermarket chain as an example to analyze the application of the logistics management of supermarket chain under the environment of electronic commerce. And the article shows that in the process of logistics management, enterprises pay more attention to the cost and reliability of the investment, as for the economic environment and transportation costs are considered relatively weak. On the basis of the above research, the third party logistics management model takes the most competitive advantages in cost and reliability. The second way is to consider the third party and the common distribution logistics management mode. The research of this paper has reference value to the general chain operation, and it also has reference value to other application fields.

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