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Research on Logistics Mode Selection under the Background of Cross-border E-commerce based on Grey Analytic Hierarchy Process

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Abstract

This paper has pointed out the factors affecting its logistics mode selection by analyzing the advantages and disadvantages of current cross-border e-commerce logistics mode, at the same time, adopted one case to prove the influence of these factors on the selection of cross-border e-commerce mode, aiming to provide reference of logistics mode selection for enterprises which intends to enter cross-border e-commerce industry.

Keywords: *Grey analytic hierarchy process, Cross-border E-commerce, logistics mode selection*

1. Introduction

The current situation and development trend of cross-border e-commerce can be summarized as following points: Xiangming Meng and Qianhui Tang believe that cross-border trade e-commerce is a new cross-border trade mode with prospective characteristic [1]. It just emerges in China and will become the development trend of foreign trade in China. At the same time, it points out that clearance efficiency, logistics and electronic payments as well as refund of duty restrict the development of cross-border e-commerce and corresponding solutions have been proposed for these three aspects. Jidi Zhou starts from two points: one is that it is very important for our country to develop cross-border e-commerce; the second is that the development of cross-border e-commerce in our country is feasible; analyzes the main problems met by our cross-border e-commerce deeply and proposes related suggestions and reflections from the perspectives of government, logistics and credibility *etc*., [2]. Yunbo Chen starts from the general development situation of international e-commerce as well as the development situation of cross-border e-commerce in China and summarizes the following factors restricting the development of cross-border e-commerce in Chin [3]a: incomplete overall understanding, low efficiency of clearance, higher trade cost, bad legal environment and great shortage of human resources *etc.*, The writer has proposed solutions of seizing opportunities, integrating resource and innovating customs supervision mode etc for these problems. Wailian Wang believes that under this era background, it is very important to develop cross-border e-commerce for our foreign trade enterprises to follow up with the national trade tide of new era [5]. His article starts from the rising and current situation of our cross-border e-commerce, summarizes the development advantages of our cross-border ecommerce and the formed problems and proposes constructive suggestions. Yiying Shang points out that the cross-border ecommerce market is with great potentiality and will become the high point for future competition [6]. Some researchers analyzed the current development situation of our cross-border e-commerce, discovers that the poor information connection and imperfect policies environment affects the logistics of cross-border

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e-commerce and puts forward ways of promoting its logistics development from four aspects of establishing and management of overseas warehouse, prediction and supervision of logistics, supply chain management method as well as different logistics modes for different countries [7-18].

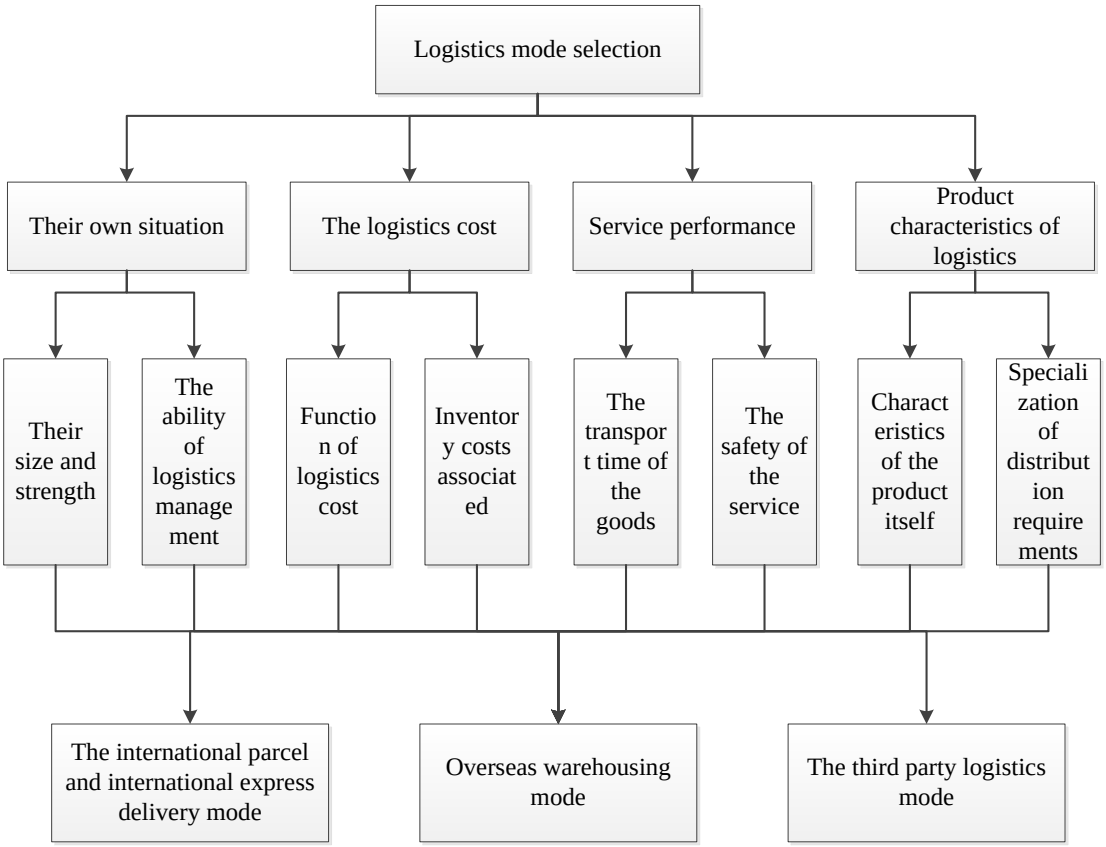

Figure 1. Logistics Mode Selection Evaluation System

Generally speaking, cross-border e-commerce is popular research topic in recent years. In addition, with the development of international trade, cross-border e-commerce will also attain rapid development. But during its development, it has been restricted by logistics and other aspects, which is also the reason in this paper to study cross-border e-commerce from the perspective of logistics mode selection. Cross-border e-commerce market is with infinite potentiality and will become the high point for future competition.

2. Analysis of Influencing Factors of Logistics Selection in Cross-Border E-commerce

2.1. Macro Factors Analysis

Under the environment of current cross-border e-commerce, firstly it needs to analyze the influence of macro factors on the logistics mode of cross-border e-commerce. Analysis of macro impact factors is helpful to understand the changes of cross-border e-commerce brought about by related policies and laws and regulations. Cross-border e-commerce enterprises should make full use of related laws, regulations and policies to promote the development of cross-border e-commerce. At the same time, analysis of macro factors is helpful to recognize the development situations current economy especially logistics industry and to face up with the existing problems; is helpful to inject new energy to related logistics market to drive its reform.

Table 1. Chinese Cross-Border E-Commerce Related Index in 2008-2013

Year	Cross-border business deals	GDP	The total import and export goods	Freight turnover	Express delivery business	The postal business volume	Internet access number
2008	0.8	314254.2	145585.5	110300	152452.3	1405	29800
2009	0.9	325145.3	154212.1	122122	184256.2	1630	35600
2010	1.3	410212.1	203125.2	124520	231121.2	1985.2	45120
2011	1.8	412502.6	231542.2	142510	322021.2	1620.2	52100
2012	2.2	512402.0	212362.2	152304	521120.6	2014.7	56900
2013	3.0	541256.6	251236.6	163202	622540.4	6210.3	62500

(1) Policy factors

On Aug. 21st 2013, office of the State Council transferred "Opinions on Implementing Related Policies Supporting Cross-border E-commerce Retail Export". These opinions can be divided into three parts: the first part is some specific policies for support; the second part is implementation requirement, which is to make trial implementation of this policy in clearance service pilots of cross-border e-commerce, namely Shanghai, Chongqing, Hangzhou, Ningbo and Zhengzhou five cities. The third part is other matters. The main purpose of these opinions is supporting cross-border e-commerce retail export, which is devoted to solving the practical problems existed in current cross-border e-commerce mode. Because in current mode, with the rapid development of our cross-border e-commerce, conditions of come management system and policies and regulations can't meet the requirements of cross-border e-commerce development.

(2) Economic factors

With the development of economy, consumers have higher and higher requirements for purchasing; when the domestic market is unable to meet their demands, consumers will turn their attention to overseas market. It can be learned from our per capita consumption level data that the continuously increasing per capita consumption is a big opportunity for cross-border e-commerce. It is also with the development of economy, cross-border e-commerce logistics mode has changed from traditional "container" transportation to current various modes; the enterprises have the ability of building overseas warehousing and choosing the third-party logistics to provide better logistics service to consumers.

(3) Legal factors

The rapid development of cross-order e-commerce in recent years is a very serious attack for our existing international trade law system. For laws related to cross-border e-commerce, it needs more attention, specifications and adjustments. As cross-border e-commerce is with numerous processes and complicated objects involved, the selection of its logistics mode should also follow related laws and regulations; especially for clearance and taxation, related laws and regulations need to be improved as soon as possible and the development of cross-border e-commerce needs to be supported at maximum.

(4) Size of cross-border e-commerce

With continuous increasing of number of internet users, the number of people selecting cross-border purchasing under e-commerce mode is bigger and bigger. Investigation has shown that the ages of our cross-border e-commerce consumers focus on 25-30 years,

followed by 31-35 years. The age structure of consumers presents younger characteristics; related data has shown that consumers under 35 years old take up over 80% of the total consumers. It needs to mention that the group of 25-30 years old who just started to work takes up nearly 40% of the total. The career of this group of people is expected to enter steadily rising stage and their salaries will increase accordingly, which will contribute to the gradual increase of cross-border online shopping market.

2.2. Micro Factor Analysis

(1) Nature of goods

For goods with high value, low weight and quick updating period like cell phones, computers and high-tech products etc, they are suitable to select business express, which is with very transparent information mechanism and meets the checking demands of customers for logistics information. Compared with small post package, it is with strong timeliness and can reach the destination in 3-5 days generally. The most important point is that it is relatively safe, for goods with high value; it brings about the biggest marginal utility and can take better logistics service to customers.

(2) Selecting subject

The size and strength of enterprise is one of the important expressions of main body of cross-border e-commerce logistics mode selection, which affects the selection of e-commerce enterprises for logistics mode to some extent. Enterprises with different sizes also have different requirements for logistics. For big cross-border e-commerce enterprises with big sizes, adequate capitals and big goods delivery amount, they hope to view logistics problem from the perspective of the whole supply chain, in addition, they have the ability of mastering the dominant power of delivery and be customer-focused. Correspondingly, it has high requirements for timeliness, at the same time; it can deliver the goods to customers safely. Under such situation, it has higher requirement for the autonomy of logistics. For small cross-border e-commerce enterprises with small sizes and inadequate capital ability, they do not have autonomy for logistics and prefer to choose relatively economic logistics mode for transportation. Cross-border e-commerce enterprises with different sizes and different strengths have different requirements for logistics.

3. Selection of Cross-Border E-Commerce Logistics Modes based on Grey Analytic Hierarchy Process

The basic principle of grey analytic hierarchy process is as following: first, construct hierarchy of index system; divide hierarchy into objective layer, criteria layer, index layer; evaluate index layer with adoption of grey evaluation method; and then apply the evaluation result of index layer into the grey evaluation of each index in criteria layer; evaluate index in bottom-up way; attain the comprehensive evaluation result of objective layer; and then rank the evaluation results. It is a non-mathematical statistics method combining analytic hierarchy process and grey system theory organically, which is mainly for situations with less data or incomplete data, moreover, most of it used to solve the evaluation of uncertain problems of “small data” and “poor information” *etc.*, The specific steps of grey multi-level analysis method are as following:

3.1. Determine the Grading of Multi-Level Grey Evaluation Index

Set evaluation level as nine-level scoring criteria, as shown in Table 2.

Table 2. The Scoring Criteria Evaluation Grades

Scoring criteria	meaning
9	Very high
7	High
5	General
3	Poor
1	Very poor
2,4,6,8	Between adjacent indicators

3.2. Attain Sample Matrix of Index Evaluation

Score each index, the score value of $r(r=1,2,3,\cdots,m)$ times score can be expressed with $fijm$, create index sample matrix.

3.3. Confirm Index Evaluation of Grey

Select five grades of "excellent", "good", "average", "bad" and "worse", expressed with numbers of 1, 2, 3, 4 and 5 respectively. The grey function of the first grey class, that is "excellent", is (because the evaluation grade at this moment is 9)

$$\varphi_1(f_{ijr})=\begin{cases}1 & f_{ijr}\geq 9\\ \dfrac{f_{ijr}}{9} & 0<fi_{jr}<9\\ 0 & f_{ijr}\leq 0\end{cases} \tag{1}$$

The grey function of the second grey class, that is "good", is (because the evaluation grade at this moment is 7)

$$\varphi_2(f_{ijr})=\begin{cases}\dfrac{f_{ijr}}{7} & 0<f_{ijr}<7\\ \dfrac{14-f_{ijr}}{7} & 7<f_{i\,jr}<14\\ 0 & f_{ijr}\leq 0\end{cases} \tag{2}$$

The grey function of the third grey class, that is "average" is (because the evaluation grade at this moment is 5)

$$\varphi_3(f_{ijr})=\begin{cases}\dfrac{f_{ijr}}{5} & 0<f_{ijr}<5\\ \dfrac{10-f_{ijr}}{5} & 5<f_{i\,jr}<10\\ 0 & f_{ijr}\leq 0\end{cases} \tag{3}$$

The grey function of the fourth grey class that is "bad" is (because the evaluation grade at this moment is 3)

$$\varphi_4\left(f_{ijr}\right)=\begin{cases}\dfrac{f_{ijr}}{3} & 0<f_{ijr}<3\\ \dfrac{6-f_{ijr}}{3} & 3<f_{ijr}<6\\ 0 & f_{ijr}\le 0 or f_{ijr}>6\end{cases} \quad (4)$$

The grey function of the fifth grey class that is "worse" is (because the evaluation grade at this moment is 1)

$$\varphi_4\left(f_{ijr}\right)=\begin{cases}1 & 0<f_{ijr}<1\\ 2-f_{ijr} & 1<f_{ijr}<2\\ 0 & f_{ijr}\le 0 or f_{ijr}>2\end{cases} \quad (5)$$

(4) Calculate grey evaluation and its calculation formula is $X_{ijr}=\varphi x\left(f_{ij1}\right)+\varphi x\left(f_{ij2}\right)+\cdots+\varphi x\left(f_{ijm}\right)$;

(5) Calculate grey evaluation weight vector and weight matrix;

Calculate the score vector B_i of sub criterion layer and the weight w_i of main criterion layer through formula $B_i=w_iR$, $B=w_i\begin{bmatrix}B1\\B2\\B3\\B4\end{bmatrix}$, transfer evaluation rating to vector C, $C=[9,7,5,3,1]$, $Z=BC^T$, and then the value of Z can be calculated.

Table 3. A Company's Financial Data

	2011Q1	2011Q2	2011Q3	2011Q4	2012Q1	2012Q2	2012Q3	2012Q4
Net revenue	27425	27542	28515	30251	36201	38254	39545	21525
Gross profit margin	28.5	36.2	35.1	32.8	31.6	35.9	40.1	41.7
The logistics cost	1620	1325	1954	2201	2051	2317	2415	2254
Logistics costs accounted for	5.21	4.49	7.02	6.66	5.52	5.04	4.12	4.10
Sales and marketing costs	9986	8502	10245	9111	10782	13455	14028	15245
Marketing costs accounted for	33.6	31.25	37.01	28.69	29.51	10.22	24.58	25.16
Management fees	3325	4545	3636	4900	5010	5080	6521	6540
Management	11.90	16.32	13.25	14.20	13.58	10.25	10.39	10.94

fees accounted for								
Net profit	-6256	-4532	-5021	-7251	-2102	-1326	1150	2610

(6) Calculate comprehensive score

4. Cases of Cross-border E-commerce Logistics Modes Selection

4.1. Company Profile

The main categories of A Company include clothing, electronic products, accessories, household products and sports goods etc, 14 categories and over 60,000 products in total. After development in recent years, A Company purchases goods from all over China, has suppliers in Guangdong, Shanghai, Beijing and other places and accumulates very good reputation. Of course, it attracts the participation of many brands, including Newman, Patriot, Founder Technology, Shenzhou Computer and other famous brands and all has become partners or suppliers of the company.

Table 4. Product Category A Company Revenue

	2010		2011		2012	
dress	19452	33.6%	482122	40.2%	80121	40.1
Electronic and communication equipment	263012	44.2%	23655	31.2%	42010	21.3
Parts distribution	1524	2.3%	11770	10.1%	40122	22.6
Home gardening	4011	6.5%	13520	11.6%	21360	12.6
other	7302	12.3%	7410	6.3%	12012	7.5 %
Total revenue	58620	100%	112362	100%	20112	100

Table 5. The International Parcel Sample Evaluation Matrix Table and International Express Delivery Mode

	1	2	3	4	5
U11	2	1	2	3	3
U12	4	3	6	3	4
U21	5	5	3	6	7
U22	3	4	7	3	4
U31	6	6	4	5	6
U32	3	8	4	4	8
U33	7	4	7	7	2
U41	8	5	6	7	6
U42	6	7	7	5	4

A Company website has clients from over 100 countries, the access data is amazing and the foreign access amount exceeds 200,000. At present, this website has over millions of registered clients; covering all over the world and its destinations have over 200 countries. As shown on prospectus, LightlnTheBox has created net revenue of 0.2 billion US dollars in 2012 with net loss of 2.33 million US dollar. It prepares to be listed in America and the financing ceiling is 86.25

million US dollar. In the following it will make related analysis of financial data and the following is financial data sheet of A Company from 2011 to the first quarter of 2013.

4.2. Construction of Logistics Mode Selection Index System

Rough analysis has been made for logistics mode of A Company from macroscopic and microscopic perspectives in the above, but all of them are subjective evaluations, so it is not strongly persuasive. In the following, quantitative analysis has been made for the logistics mode selection of A Company. It is also mentioned in the former analysis that there are many methods for logistics mode selection, but is inadequate in the selection of cross-border e-commerce logistics mode, therefore, this paper can only make summarization and improvement based on former paper basis and questionnaires and creates evaluation index system suitable for selection of cross-border e-commerce logistics mode. At the same time, it adopts fuzzy analytic hierarchy process and grey analytic hierarchy process when calculating indictor weight, the main reason lies in the fact that index data is incomplete under different logistics modes and the attained effect data is poor, in addition, distinctive hierarchy exists among indexes. In conclusion, the adopted calculation method in this paper has been attained through comparing with various methods. Based on results of questionnaire as well as former analysis, main factors influencing the selection of cross-border e-commerce logistics mode include: nature of goods, enterprise size and strength, timeliness, position of logistics in system and total system cost *etc.*, This paper establishes evaluation system as shown in picture 1 on the basis of checking related literatures and combining investigation results of questionnaire.

4.3. Attain Sample Matrix of Index Evaluation

In the questionnaire, 5 experts have scored each index system. The evaluation system matrix of postal packet and international express is as shown in table 5.

It can be obtained by calculation that: Z1=6.11, Z2=7.046, Z3=5.94.

It can be learned from the above construction of index system as well as calculation results of fuzzy analytic hierarchy process and grey analytic hierarchy process that overseas warehousing mode for the aspect of logistics mode evaluation in A Company is with the highest score, therefore, based on current situation, A Company is suggested to choose overseas warehousing mode. This result is in line with current warehouses in Europe and America. The establishment of logistics platform for A Company global cross-border e-commerce needs more participation of providers of global quality logistics distribution service.

5. Conclusion

This paper firstly analyzes the development situation of cross-border e-commerce, makes deep research on the changing of logistics modes in our cross-border e-commerce and at the same time, evaluates the advantages and disadvantages of logistics modes of our current cross-border e-commerce. When analyzing the influencing factors, this paper adopts questionnaires to explore the specific factors enterprises considered when selecting suitable logistics modes, designs an evaluation index for Company A based on these influencing factors, adopts fuzzy analytic hierarchy process and grey analytic hierarchy process to calculate the comprehensive evaluation indexes of each logistics mode and proposes related comments and suggestions for suitable logistics modes of A Company. Cross-border e-commerce enterprises should fully consider about their comprehensive strength,

property and timeliness of main cargos and total logistics cost etc when selecting suitable logistics modes. It needs to make suitable adjustment for its macro environment when selecting logistics modes.

References

[1] A. Asosheh and H.S. Nejad, "A Model of a Localized Cross-Border E-commerce", IBusiness, vol. 4, no. 12, **(2016)**, pp. 2-3.
[2] A. Patrikios, "The role of transnational online arbitration in regulating cross-border e-business", Computer Law & Security Review, vol. 21, no. 7, **(2008)**, pp. 66-76.
[3] Z. lin, "The institutional environment for global e-commerce diffusion: A cross-country investigation", Long Island University, C.W. Post Campus, United States, vol. 12, no. 3, **(2008)**, pp. 229-241.
[4] C. Bill, "Privacy cryptography and global e-commerce", Telecommunication Journal of Australia, vol. 22, no. 4, **(1998)**, pp. 15-20.
[5] N. Gordian, "Legal determinants of the global spread of e-commerce", International Journal of Information, vol. 12, no. 22, **(2008)**, pp. 181-194.
[6] M. M. Lynne, "Structural influences on global e-commerce activity", Journal of Global, vol. 3, no. 22, **(2002)**, pp. 5-12.
[7] A.A. Hassan, "Global e-commerce: A framework for understanding and overcoming the trust barrier", Daniel Source, vol. 22, no. 12, **(2003)**, pp. 130-138.
[8] H. Leea and S. Whang, "Winning the last mile of E-commerce", MIT Sloan Management Review, vol. 23, no. 21, **(2002)**, pp. 123-129.
[9] C. C. Poirier and M. J. Bauer, "E-Supply Chain", Barrett-Koehler Publishers Inc, vol. 23, no. 10, **(2000)**, pp. 45-48.
[10] E. G. Herrera, B. Martens and G. Turlea, "The drivers and impediments for cross-border e-commerce in the EU", Information Economics and Policy, vol. 25, no. 2, **(2014)**, pp. 83-96.
[11] W. Ambrosini, P. D. Marco and J. C. Ferreri, "Linear and nonlinear analyis of density-wave instability phenomena", International Journal of Heat and Technology, vol. 18, no. 1, **(2000)**, pp. 23-26.
[12] M. Quintard and J. R. Puiggali, "Numerical modelling of transport processes during the drying of a granular porous medium", International Journal of Heat and Technology, vol. 4, no. 2, **(1986)**, pp. 37-57.
[13] J. Chengfeng, W. Zhang and Y. Ying, "A micro-gesture recognition on the mobile web client", Review of Computer Engineering Studies, vol. 2, no. 2, **(2015)**, pp. 19-24.
[14] R. Jin, L. Hong, C. Wang, L. Wu and W. Si, "A Hierarchical clustering community algorithm which missed the signal in the process of transmission", Review Of Computer Engineering Studies, vol. 2, no. 3, **(2015)**, pp. 27-34.
[15] Y. Zhao, C. Feng, J. Yang and L. Wang, "LITERATURE REVIEW OF NETWORK PUBLIC OPINION ABOUT THE E-COMMERCE", Review of Computer Engineering Studies, vol. 2, no. 2, **(2015)**, pp. 25-30.
[16] J. H. Tu and Z. Quan, "Design and implementation od the crying voice detection circuit in the baby's supervision system", Review of Computer Engineering Studies, vol. 1, no. 1, **(2014)**, pp. 13-16.
[17] R. Jin, K. Chunhai and R. Liu, "Biclustering algorithm of differential co-expression for gene data", Review of computer engineering studies, vol. 102, no. 10, **(2014)**, pp. 7-12.
[18] H. S. Pang, "Research on Optimization of B2C E-commerce Service Quality Oriented by Customer Demand", Revista de la Facultad de Ingeniería, vol. 31, no. 6, **(2016)**, pp. 103-113

