

# Empirical study of C2C logistics customer satisfaction based on AHP and FCE

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## Abstract

Evaluation system of C2C logistics customer satisfaction was mainly studied here. Firstly, three primary indexes and nine secondary indexes were constructed as the components of the evaluation system. Then the integrated use of AHP and FCE was carried on taobao.com as the empirical research. The result indicates that the overall logistics customer satisfaction of taobao.com is good. But there is still space for improvement. Through this study, logistics customer satisfaction of taobao.com is to improved. In addition, references are provided for other C2C enterprises and logistics companies. The common development of them is therefore promoted.

*Keywords:* C2C logistics customer satisfaction, AHP, FCE

## 1 Introduction

As more and more people enjoy online shopping, in recent years China e-commerce has gained explosive growth. Online shopping boom is arriving. China has also rapidly changed from the distributed shopping to scale shopping. The running condition of the whole country's postal service announced by China Post Office, says that the express industry has gained a growth more than 27% for five years in a row, over half of which is from e-commerce, indicating that e-commerce logistics is very important in the logistics industry. Meanwhile as the only face-to-face process in the whole e-commerce marketing, e-commerce logistics becomes one important factor in the successful development of e-commerce [1, 2].

How to provide effective e-commerce logistics service for customers, is not only the problem e-commerce merchant cares, but also the logistics company concerns [3]. Whether customer is satisfied with the logistics services, not only affects the cooperation between merchants and customers, but also affect the business cooperation between merchants and logistics companies [4]. In current social situation, the construction of the express logistics system in our country is still in its infancy, which has not yet formed its mature system. At the same time, employee diathesis of the express logistics is generally not high, which becomes the factor that makes customer dissatisfied [5]. Scholars and researchers have made many relative studies. But current research is mainly qualitative research, there is rarely quantitative research. In addition, relative research of logistics customer satisfaction of C2C is a little.

By quantitative analysis of customer satisfaction logistics of C2C companies through AHP and FCE, they can find explicitly, which aspects they did not well. So in

the future these aspects are improved to serve customers better, thereby to increase their marketing activities. It can also standardize and improve those marketing activities, so to give impetus to the development of C2C enterprises and logistics industry.

## 2 Construction of evaluation index system

Through analysis of related literature and combining with the practical research experience [6-11], following the principle of science, integrity, operability, comparability, and analysis of qualitative and quantitative, the evaluation index system of C2C logistics customer satisfaction this study built is as follows.

### 2.1 TARGET LAYER

It is the highest level, as C2C logistics customer satisfaction (A).

### 2.2 PRIMARY INDEXES

The target layer is decomposed into three primary indicators, respectively are delivery speed and price ( $A_1$ ), corporate image ( $A_2$ ), and quality of service ( $A_3$ ), as shown in Figure 1.

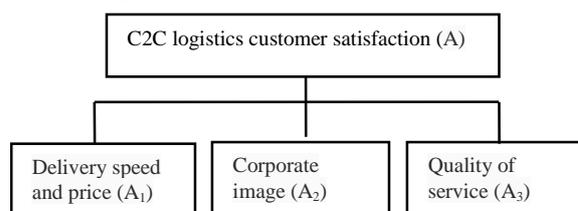


FIGURE 1 Primary evaluation indexes of C2C logistics customer satisfaction

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## 2.3 SECONDARY INDEXES

Three primary indexes are decomposed into nine secondary indicators, as shown in Table 1.

TABLE 1 Evaluation index system of c2c logistics customer satisfaction

Evaluation target	Primary indicators	Secondary indicators
C2C logistics customer satisfaction (A)	Delivery speed and price (A <sub>1</sub> )	Speed of delivery (B <sub>1</sub> )
		Cargo tracking and feedback (B <sub>2</sub> )
		Logistics fee (B <sub>3</sub> )
	Corporate image (A <sub>2</sub> )	Enterprise brand (B <sub>4</sub> )
		Credibility of enterprises (B <sub>5</sub> )
		Enterprise staff quality (B <sub>6</sub> )
	Quality of service (A <sub>3</sub> )	Packing integrity (B <sub>7</sub> )
		Treatment of emergency (B <sub>8</sub> )
		Integrity of goods (B <sub>9</sub> )

Delivery speed and price (A<sub>1</sub>) consists of three secondary indicators: 1) the speed of delivery (B<sub>1</sub>) refers to the time from purchase to receive goods for the customers; 2) the cargo tracking and feedback (B<sub>2</sub>) refers to the network information timeliness and validity during the distribution process of goods; 3) logistics fee (B<sub>3</sub>) is to pay the price of the logistics by customers.

Corporate image (A<sub>2</sub>) consists of three secondary indicators:

1) enterprise brand (B<sub>4</sub>) refers to the business philosophy, corporate culture, corporate values and attitude to consumers, etc.;

2) credibility of enterprises (B<sub>5</sub>) mainly refers to how the enterprise credit is;

3) enterprise staff quality (B<sub>6</sub>) refers to the comprehensive quality of the main employees, which consists of the basic quality, professional quality and political quality.

Quality of service (A<sub>3</sub>) consists of three secondary indicators:

1) packing integrity (B<sub>7</sub>) refers to whether outer packaging of goods is complete;

2) treatment of emergency (B<sub>8</sub>) refers to whether logistics companies actively cooperate with the customers to deal with unexpected problems;

3) integrity of the goods (B<sub>9</sub>) refers to the quantity and quality of the goods customers received has not been changed.

## 3 Evaluation method

C2C logistics customer satisfaction is influenced by many factors [12-15], so to build index system need to consider from many aspects, in order to objectively and comprehensively reflect the customer satisfaction level of C2C logistics. This paper uses the analytic hierarchy process (AHP) to determine the weights of each layer of the index system, and makes comprehensive evaluation combining with Fuzzy Comprehensive Evaluation (FCE).

## 3.1 ANALYTIC HIERARCHY PROCESS

AHP (Analytic Hierarchy Process, AHP for short), is a multi-objective decision-making method used to handle limited solutions. Its basic method is to establish a hierarchy structure model. After the hierarchy model is set up, each two elements of every layer index are compared, so as to construct the judgment matrix. To fill the results of comparison in the judgment matrix, eigenvalue and eigenvector of the judgment matrix are solved, and then the weighting coefficient of the importance of each target is determined.

## 3.2 FUZZY COMPREHENSIVE EVALUATION

Fuzzy Comprehensive Evaluation (referred to as FCE) is a kind of effective multi-factor decision method, making comprehensive evaluation on objects affected by various factors. The evaluation result is based on a fuzzy set with quantitative description.

While FCE is used, expert investigation method is chosen. This method is to make expert evaluation questionnaire, each index is concluded according to the experience of experts. Through statistics of a few expert questionnaires, corresponding frequency of each factor is got. Using normalization, the corresponding grade degree of membership of each factor is got, so the single evaluation matrix is obtained, namely the degree of membership = (the number thought factor i belongs to comment j)/(the total number of evaluation experts).

## 4 Empirical study

### 4.1 CASE STUDIES

Here China's largest C2C online retail platform taobao.com is taken as the study case.

Everyday taobao.com has large quantities of customers, it also brings the demand of goods logistics. Sellers on taobao.com come into contact with many logistics companies, and many sellers even cooperate with several logistics companies at the same time. When a customer receives the goods sent from different logistics companies, the feeling of service is also different. The logistics situation of taobao.com is reflected in the following aspects.

The first is about the cargo information tracking problem. After people shopping on the Internet, they will be eager to know when their goods ship and where goods arrive after shipment. However, currently logistics companies have not done well in the aspect of networks. After purchase, a lot of customers check the cargo tracking information on the Internet, it often appears "temporarily unable to query". Therefore, that customers can't have effective understanding and tracking about their goods. Customer's demands are not well met; naturally, customer satisfaction would be affected a lot.

Second is the service of express and speed, and so on, which can be divided into two phenomena. One is that online sellers use one more express companies, when a customer receives the goods from different logistics companies, his feel of service is also not the same. When the difference of the service attitude is large, it will cause customer's dissatisfaction. The other is due to the logistics company itself. Logistics time delay leads to customer's waiting too long and causes their dissatisfaction, which directly affects the logistics customer satisfaction.

The third is the product packaging and damage rate. When customers find their commodity packaging is not complete, it will cause customer dissatisfaction, which even lead to the customer's request to return. Most of the time the outer packaging of goods is intact, but after opening, the inside products are found damaged. Obviously, customers will have strong displeasure, so that the satisfaction will drop sharply.

4.2 EVALUATION PROCESS

Firstly using AHP to respectively determine the weights of all levels of the evaluation system, then to use expert evaluation method, to give comprehensive grade of each index, to get fuzzy matrix of two level indexes, thus can get comprehensive evaluation vector at all levels.

Firstly to establish the judgment matrix of the secondary sub-indexes elements to A<sub>1</sub> (here ten experts are invited to participate in the questionnaire, the raw data in this article is the average value of the experts' scoring), as shown in Table 2. To adopt AHP to calculate the weights at various levels, then are checked through the consistency test.

TABLE 2 Judgment matrix of A<sub>1</sub> and the corresponding weights

A <sub>1</sub>	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	weights
B <sub>1</sub>	1	1	577/300	0.394
B <sub>2</sub>	1	1	64/30	0.408
B <sub>3</sub>	300/577	30/64	1	0.198

The consistency check are: λ<sub>max</sub>=3.001, CI=0.0005, CR=0.00086<0.1.

In the same way, the judgment matrix of the other secondary sub-indexes elements to A<sub>2</sub> and A<sub>3</sub> and the corresponding weights are obtained as shown in Table 3 and Table 4.

TABLE 3 Judgment matrix of A<sub>2</sub> and the corresponding weights

A <sub>2</sub>	B <sub>4</sub>	B <sub>5</sub>	B <sub>6</sub>	weights
B <sub>4</sub>	1	17/10	36/10	0.525
B <sub>5</sub>	10/17	1	57/20	0.342
B <sub>6</sub>	10/36	20/57	1	0.133

The consistency check are: λ<sub>max</sub>=3.009, CI=0.005, CR=0.0086<0.1.

TABLE 4 Judgment matrix of A<sub>3</sub> and the corresponding weights

A <sub>3</sub>	B <sub>7</sub>	B <sub>8</sub>	B <sub>9</sub>	weights
B <sub>7</sub>	1	551/300	727/300	0.512
B <sub>8</sub>	300/551	1	311/300	0.258
B <sub>9</sub>	300/727	300/311	1	0.230

The consistency check are: λ<sub>max</sub>=3.006, CI=0.003, CR=0.006<0.1.

Fuzzy comprehensive evaluation of those indexes by data are made, for which the raw data comes from the results summary of 135 questionnaires and 10 experts questionnaires before, to get the fuzzy matrix which is as follows:

$$R_{A1(3 \times 5)} = \begin{pmatrix} 0.062 & 0.566 & 0.324 & 0.048 & 0.000 \\ 0.076 & 0.434 & 0.379 & 0.097 & 0.014 \\ 0.076 & 0.524 & 0.331 & 0.069 & 0.000 \end{pmatrix}$$

$$R_{A2(3 \times 5)} = \begin{pmatrix} 0.028 & 0.490 & 0.448 & 0.028 & 0.000 \\ 0.056 & 0.480 & 0.410 & 0.040 & 0.014 \\ 0.065 & 0.400 & 0.434 & 0.090 & 0.000 \end{pmatrix}$$

$$R_{A3(3 \times 5)} = \begin{pmatrix} 0.076 & 0.593 & 0.270 & 0.055 & 0.006 \\ 0.041 & 0.379 & 0.476 & 0.090 & 0.014 \\ 0.041 & 0.338 & 0.428 & 0.124 & 0.069 \end{pmatrix}$$

Based on the common matrix multiplication operator ".", fuzzy operation is made. "." means generalized synthesis operator. Matrix synthesis is (Λ, V), that is the elements of B is:

$$b_j = \sum_{i=1}^m + a_i \cdot r_{ij} = (a_1 \cdot r_{1j}) \cdot (a_2 \cdot r_{2j}) \cdot \dots \cdot (a_m \cdot r_{mj}), \quad (1 \leq j \leq n)$$

The evaluation fuzzy sets of the secondary indexes are obtained:

$$B = A \cdot R = (0.394, 0.408, 0.198) \cdot \begin{pmatrix} 0.062 & 0.566 & 0.324 & 0.048 & 0.000 \\ 0.076 & 0.434 & 0.379 & 0.097 & 0.014 \\ 0.076 & 0.524 & 0.331 & 0.069 & 0.000 \end{pmatrix} = (0.076, 0.408, 0.379, 0.097, 0.014)$$

Normalized to get:

$$B_{A1} = (0.078, 0.419, 0.389, 0.100, 0.014)$$

By the same token, the results of the operations of fuzzy evaluation to other factors are:

$$B_{A2} = (0.056, 0.444, 0.405, 0.082, 0.013)$$

$$B_{A3} = (0.060, 0.407, 0.379, 0.099, 0.055)$$

In the same way, the judgment matrix of the primary indexes with application of AHP is got, and the weights are calculated, as shown in Table 5.

TABLE 5 Judgment matrix of A and the corresponding weights

A	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	weights
A <sub>1</sub>	1	107/60	88/30	0.523
A <sub>2</sub>	60/107	1	221/120	0.305
A <sub>3</sub>	30/88	120/221	1	0.172

Details are shown as in Table 6.

TABLE 6 Evaluation results of c2c logistics customer satisfaction

Primary index	weights	Secondary index	weights	fuzzy comprehensive evaluation				
				secondary evaluation vector				
Delivery speed and price (A <sub>1</sub> )	0.523	Speed of delivery (B <sub>1</sub> )	0.394	0.078	0.419	0.389	0.1	0.014
		Cargo tracking and feedback (B <sub>2</sub> )	0.408					
		Logistics fee (B <sub>3</sub> )	0.198					
Corporate image (A <sub>2</sub> )	0.305	Enterprise brand (B <sub>4</sub> )	0.525	0.056	0.444	0.405	0.082	0.013
		Credibility of enterprises (B <sub>5</sub> )	0.342					
		Enterprise staff quality (B <sub>6</sub> )	0.133					
		Packing integrity (B <sub>7</sub> )	0.512					
Quality of service (A <sub>3</sub> )	0.172	Treatment of emergency (B <sub>8</sub> )	0.258	0.060	0.407	0.379	0.099	0.055
		Integrity of goods (B <sub>9</sub> )	0.230					
				primary evaluation vector				
				0.072	0.410	0.374	0.093	0.051

### 4.3 EVALUATION RESULTS

This paper makes fuzzy comprehensive evaluation of logistics customer satisfaction of taobao.com from delivery speed and price, corporate image and quality of service. The results show that according to the principle of maximum membership degree, the value of logistics customer satisfaction of taobao.com is 0.410, the result is better, which means logistics customer satisfaction of taobao.com is ok, but there is still room for improvement.

Combining with Table 6, this paper makes detailed analysis is as follows:

In the primary indexes, the weight of delivery speed and price is the biggest, the value of which is 0.523. According to the principle of maximum membership degree, the value of maximum membership degree of FCE is 0.419, the result of evaluation is well. Under its three secondary indexes, the weight of cargo tracking and feedback is the largest, whose value is 0.408. It is not difficult to find whether can effectively provide cargo tracking and feedback will have huge impact on logistics customer satisfaction.

Under the index of enterprise image, the weight of enterprise brand is the biggest, the value of which is 0.525. From this, it can easily find that customers pay much attention to it. Therefore, how to effectively improve the brand of logistics enterprises will affect the logistics customer satisfaction of taobao.com.

Among the primary indexes, quality of service weights the smallest, whose value is only 0.172. The weight of its subordinate indicators - packaging integrity, treatment of emergency, integrity of goods---respectively is 0.512, 0.258, 0.230. Can say that within service, the influence packaging integrity making on customer's satisfaction is the biggest. According to the principle of maximum membership degree, the value of FCE is 0.407, showing that the result is good. However, taobao.com can do better in service, such as improving the treatment of emergency, integrity of goods, etc.

The consistency check are:  $\lambda_{max}=3.001$ ,  $CI=0.0005$ ,  $CR=0.00086<0.1$ .

To make fuzzy comprehensive evaluation of the primary indexes, the fuzzy evaluation vector obtained is as follows:  $B_A=(0.072, 0.410, 0.374, 0.093, 0.051)$ .

From above analysis, it can conclude that for taobao.com customers value delivery speed and price the most, second is the brand of logistics companies, the last is quality of service. Therefore, for customers after purchase, they particularly value when goods can arrive and how much the price of logistics is. Compared with the entity store shopping, the advantage of online shopping is convenient and cheap, but it also has shortcoming that customers cannot immediately get the merchandise they buy. How to shorten the time from ordering the goods to receiving the goods for customers, can not only promote better development of e-commerce logistics and taobao.com, but also improve customer satisfaction of e-commerce logistics.

### 5 Conclusions

This paper mainly studies customer satisfaction evaluation system of C2C logistics. From this research, can know what customers care much, so it can not only improve the quality of logistics service, but also let the C2C businesses choose better logistics enterprises, to improve customer satisfaction, so as to promote the rapid development of e-commerce.

This work only evaluates logistics customer satisfaction of pattern C2C, but for other e-commerce modes, such as B2B, B2C, O2O, etc., are not studied here. In addition, due to limit academic accumulation and limited time, there are many deficiencies, please comment.

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