Research on the Evaluation of Terminal Express Service Quality in the Context of Epidemic

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Abstract. During the epidemic, improving the service quality of terminal logistics is helpful to promote the benign development of the economic environment. Therefore, this paper firstly combined AHP analysis with TOPSIS method, and used Delphi method to invite 5 professionals to give weight scores to the indicators. Secondly, the index weight and other related data are integrated and processed, and then the weight indicators at all levels are determined. Finally, the second level index is evaluated and analyzed. In this paper, the service quality of Yunda Express in Shenfu Reform and innovation Demonstration Zone under the background of the epidemic was analyzed. The service quality reform mode which is beneficial to the future development direction of enterprises has certain reference significance for the development of related enterprises.

Keywords: Epidemic · Service quality · AHP analysis · TOPSIS

1 Introduction

The normalization of the epidemic has had a huge impact on various industries. A large number of logistics enterprises strive to improve the overall quality of service. Therefore, this paper reviews the service quality of terminal express under the background of epidemic. In the current situation, it is of great practical significance to analyze the influencing factors of terminal express service quality.

In recent years, many scholars have made achievements in the quality of terminal express service. Zhang Baoyou and others divided the research on logistics service quality into three stages: concept formation, model construction and service quality theory expansion. The model construction in the second part is the basis of logistics service quality evaluation [1]. Based on this, Zhuang Zhijie and Yang Yanhui set out from the characteristics of digital economy development. A comprehensive evaluation system for cross-border e-commerce service quality has been established. The entropy weight TOPSIS model was used to analyze the key factors affecting the service quality of cross-border e-commerce under the background of digital economy [2]. At the same time, Li Hui and Li Hangmin took terminal logistics as the object to study its logistics service quality. They set up the evaluation index system from tangibility, responsiveness,

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reliability, assurance, empathy and convenience [3]. Zhang decided to start from the end of express delivery in 2021 to study its service quality. It is found that logistics robot technology is the general trend of logistics development. We should cultivate relevant talents, standardize industry management and find new development modes to conquer the core technology [4].

Throughout the existing research findings, scholars mostly analyze the service quality of terminal logistics at the macro level. In fact, under the background of the epidemic, the quality of terminal express logistics service has become more complex.

Therefore, in this paper, the current situation of service quality of Yunda Express (hereinafter referred to as "Shenfu Yunda") in Shenfu Reform and innovation Demonstration Zone under the background of the epidemic was taken as an example. The questionnaire survey on service quality was conducted to evaluate the service quality.

2 Model Building

2.1 Construction of Evaluation Model

In this paper, AHP analysis method and TOPSIS were mainly used to evaluate the quality of terminal express service under the background of epidemic. Taking the scale as the basis of its establishment and the characteristics of the express industry as the main frame, the following impact indicators are finally determined. Table 1 shows that.

Table 1. Table of service quality evaluation index system

First-level indicators	Second-level indicators (%)
B_1 Reliability indicator	B_{11} Express loss degree
	B_{12} Delivery time
	B_{13} Express damage level
B_2 Tangible index	B_{21} Comfort degree of door-to-door service process
	B_{22} Staff dress cleanliness
	B_{23} Reasonable price transparency
	B_{24} Network facilities and good environment
B_3 Professional index	B_{31} Professional knowledge and skill proficiency of employees
	B_{32} Staff with good service attitude
B_4 Responsiveness index	B_{41} Tracking and querying express information speed
	B_{42} Service hotline unimpeded
	B_{43} Reasonable waiting time for sending and receiving express
B_5 Remedial index	B_{51} Appropriate degree of complaint handling time
	B_{52} Good result of complaint handling

2.2 The Analytic Hierarchy Process is Applied to Determine the Index Weight

AHP was put forward by T.L.Saaty, a famous operational research scientist, in the 1970s [5]. The scale definition of judgment matrix is shown in Table 2.

The relationship between a_{ij} and a_{ji} has the following characteristics:

$$a_{ij} = 1,\ a_{ji} = \frac{1}{a_{ij}}, (i, j = 1, 2, 3.....n) \tag{1}$$

Steps of AHP analysis:

(1) Establish hierarchy. Assume that there are m indicators and n schemes, in which the first-level indicator layer is B_i and the second-level indicator layer is B_{ij}.

(2) Establish the judgment matrix A of all levels. The maximum eigenvalue was calculated and the consistency test was carried out. Maximum eigenvalue:

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(AW)_j}{(nW_j)} \tag{2}$$

(3) The consistency ratio:

$$CR = \frac{CI}{RI} \tag{3}$$

(4) When $CR < 0.1$, the judgment matrix has satisfactory consistency. CI is the consistency indicator:

$$CI = \frac{\lambda_{\max} - 1}{n - 1} \tag{4}$$

(5) Calculate relative weight and comprehensive weight and sort.

The weight calculation method used here is sum method.

$$\omega_i = \frac{1}{n} \sum_{j=1}^{n} \frac{a_{ij}}{\sum_{k=1}^{n} a_{kj}} \tag{5}$$

Table 2. Definition of judgment matrix scal

Scale	Meaning
1	means that the two factors are equally important
3	means two factors are compared, one is slightly more important than the other
5	means that one factor is significantly more important than the other than the other
7	means that two factors are more strongly important than the other
9	indicates that two factors are more important than the other
2, 4, 6, 8	the intermediate value of the two adjacent judgments
The bottom	The comparison judgment of factor i and j is a_{ij}, then the comparison judgment of factor j and i is a_{ji}

Sorting can be divided into hierarchical single sorting and hierarchical total sorting.

2.3 TOPSIS is Adopted to Evaluate the Service Quality of Terminal Express

TOPSIS ranks the evaluation objects by calculating the distance from the optimal solution and the worst solution [6].

The ideal point method can be divided into the following three steps:

First, the original data were trended and normalized.

Then, it is concluded that the existing solutions of optimal solution set Z_{min} and worst solution set Z_{max}.

Thirdly, the distance between the evaluation object and the optimal solution and the distance between the evaluation object and the worst solution are calculated.

$$D_i^+ = \sqrt{\sum_{j=1}^{n}\left[w_j\left(z_{ij} - z_{\max}\right)^2\right]} \tag{6}$$

$$D_i^- = \sqrt{\sum_{j=1}^{n}\left[w_j\left(z_{ij} - z_{\min}\right)^2\right]} \tag{7}$$

Finally, the relative progress between the evaluation object and the optimal scheme is calculated.

$$C_i = \frac{\sqrt{\sum_{j=1}^{n}\left[w_j\left(z_{ij} - z_{\min}\right)^2\right]}}{\sqrt{\sum_{j=1}^{n}\left[w_j\left(z_{ij} - z_{\min}\right)^2\right]} + \sqrt{\sum_{j=1}^{n}\left[w_j\left(z_{ij} - z_{\max}\right)^2\right]}} \tag{8}$$

3 An Empirical Study on the Evaluation Model of Terminal Express Service Quality Based on AHP and Topsis Under the Epidemic Situation

This paper takes Shenfu Reform and Innovation Demonstration Zone as the background, its geographical location has its own characteristics, has its own research value. The half-hour economic circle of the Shenfu Reform and Innovation Demonstration Zone can cover the urban areas of Shenyang, Fushun, Benxi and Tieling, as well as major transportation hubs such as Taoxian Airport and various high-speed railway stations.

3.1 Data Reduction and Analysis Tape

At present, Shenfu Reform and Innovation Demonstration Zone is committed to the transformation and upgrading of terminal express services. Take the scale as the basic condition of its establishment. The characteristics of the express industry are regarded as the main frame. 5 dimensions and 14 indicators were determined.

A total of 470 questionnaires were received with an effective rate of about 99.78%. The reliability weight coefficient of the questionnaire was 0.977. The KMO value of the variable was 0.969. The chi-square statistic is 0.000. The validity is a good trend.

3.2 AHP is Used to Determine the Index Weight

3.2.1 Determination of the Weight of First-Level Indicators

The judgment matrix A was established by scoring the first-level indicators by 5 experts:

$$A = \begin{pmatrix} 1 & 2 & 2 & 3 & 4 \\ 1/2 & 1 & 2 & 2 & 3 \\ 1/2 & 1/2 & 1 & 2 & 2 \\ 1/3 & 1/2 & 1/2 & 1 & 2 \\ 1/4 & 1/3 & 1/2 & 1/2 & 1 \end{pmatrix} \tag{9}$$

(1) According to the normalization of judgment matrix A, the corresponding unit feature vector can be obtained:

$$W_A = (0.3641, 0.2391, 0.1993, 0.12, 0.0775)^T \tag{10}$$

(2) Find the maximum eigenvalue corresponding to the eigenvector W. $\lambda_{max} = 5.0732$.
(3) Conduct a consistency check:

When $CR < 0.1$, the judgment matrix has satisfactory consistency. According to Eqs. (3) and (4), it can be calculated as follows: $CI = 0.0183$. RI is the average random consistency index. $RI = 1.12$ by looking up the table. Then $CR = 0.0163 < 0.1$. Therefore, W_A can be used as the weight vector of the first-level index.

3.2.2 Determining the Weight of Secondary Indicators

Grade the secondary indicators by five experts. The judgment matrix is determined as follows:

$$B_1 = \begin{vmatrix} 1 & 3 & 2 \\ 1/3 & 1 & 1/2 \\ 1/2 & 2 & 1 \end{vmatrix} \tag{11}$$

$$B_2 = \begin{vmatrix} 1 & 2 & 3 & 1 \\ 1/2 & 1 & 1/2 & 1/5 \\ 1/3 & 2 & 2 & 1/3 \\ 1 & 5 & 3 & 1 \end{vmatrix} \tag{12}$$

$$B_3 = \begin{vmatrix} 1 & 2 \\ 1/2 & 1 \end{vmatrix} \tag{13}$$

$$B_4 = \begin{vmatrix} 1 & 3 & 2 \\ 1/3 & 1 & 1/2 \\ 1/2 & 2 & 1 \end{vmatrix} \tag{14}$$

$$B_5 = \begin{vmatrix} 1 & 3 \\ 1/3 & 1 \end{vmatrix} \tag{15}$$

Through calculation, the consistency test results of each secondary index are less than 0.1 (good). The weights are as follows:

$$\mathrm{B}_1:\ CR_1 = 0.0089.\ W_1 = (0.6480, 0.1222, 0.2299)^T$$
$$\mathrm{B}_2:\ CR_2 = 0.005.\ W_2 = (0.3369, 0.1055, 0.1456, 0.4119)^T$$
$$\mathrm{B}_3: CR_3 = 0.\ W_3 = (0.6667, 0.3333)^T$$
$$\mathrm{B}_4:\ CR_4 = 0.0089.\ W_4 = (0.539, 0.1638, 0.2973)^T$$
$$\mathrm{B}_5:\ CR_5 = 0.\ W_5 = (0.75, 0.25)^T$$

3.2.3 Hierarchical Comprehensive Ranking

The weights of the hierarchical comprehensive ranking are:

$$W_A = (0.2086, 0.0634, 0.115, 0.0748, 0.0234, 0.0323, 0.0914,$$
$$0.1215, 0.0607, 0.0608, 0.0206, 0.0374, 0.0624, 0.0208)$$

3.3 The Analytic Hierarchy Process is Applied to Determine the Index Weight

3.3.1 The Value of Service Quality Evaluation Index Was Normalized

$$Y = \begin{bmatrix}
0.0252 & 0.0168 & 0.0168 & 0.0168 & 0.0168 \\
0.0084 & 0.0084 & 0.0084 & 0.0084 & 0.0168 \\
0.0252 & 0.0168 & 0.0168 & 0.0168 & 0.0252 \\
0.0168 & 0 & 0.0168 & 0.0168 & 0.0168 \\
0.0168 & 0 & 0.0168 & 0.0168 & 0.0168 \\
0.0168 & 0.0084 & 0.0168 & 0.0084 & 0.0084 \\
0.0168 & 0 & 0.0084 & 0.0084 & 0.0168 \\
0.0168 & 0 & 0.0168 & 0.0168 & 0.0168 \\
0.0168 & 0.0168 & 0.0168 & 0.0168 & 0.0168 \\
0.0168 & 0.0168 & 0.0168 & 0.0168 & 0.0168 \\
0.0168 & 0.0168 & 0.0168 & 0.0252 & 0.0168 \\
0.0168 & 0 & 0.0136 & 0.0168 & 0.0168 \\
0.0168 & 0 & 0.0204 & 0.0084 & 0.0168 \\
0.0168 & 0.0168 & 0.0168 & 0.0084 & 0.0168
\end{bmatrix}$$

3.3.2 The Weighted Decision Matrix is Established

$$Z = \begin{bmatrix} 0.0053 & 0.0035 & 0.0035 & 0.0035 & 0.0035 \\ 0.0053 & 0.0053 & 0.0053 & 0.0053 & 0.0011 \\ 0.0029 & 0.002 & 0.002 & 0.002 & 0.0029 \\ 0.0013 & 0 & 0.0013 & 0.0013 & 0.0013 \\ 0.0004 & 0 & 0.0004 & 0.0004 & 0.0004 \\ 0.0005 & 0.0003 & 0.0005 & 0.0003 & 0.0003 \\ 0.0015 & 0 & 0.0008 & 0.0008 & 0.0015 \\ 0.002 & 0 & 0.001 & 0.002 & 0.002 \\ 0.001 & 0.001 & 0.001 & 0.001 & 0.001 \\ 0.001 & 0.001 & 0.001 & 0.001 & 0.001 \\ 0.0003 & 0.0003 & 0.0003 & 0.0005 & 0.0003 \\ 0.0006 & 0 & 0.0003 & 0.0006 & 0.0006 \\ 0.001 & 0 & 0.001 & 0.0005 & 0.001 \\ 0.0003 & 0.0003 & 0.0003 & 0.0002 & 0.0003 \end{bmatrix}$$

3.3.3 Positive and Negative Ideal Solution Calculation

$$Z_{\max} = (0.005, 0.005, 0.005, 0.005, 0.004)$$

$$Z_{\min} = (0, 0, 0, 0, 0)$$

3.3.4 Calculation of Distance and Closeness of Positive and Negative Ideal Solutions

Table 3. Service quality evaluation of yunda express in shenfu reform and innovation demonstration zone

serial number	D^+	D^-	C	ranking
B_{11}	0.003	0.008	0.727	2
B_{12}	0.002	0.01	0.81	1
B_{13}	0.006	0.005	0.438	3
B_{21}	0.009	0.002	0.186	5
B_{22}	0.01	0	0.025	14
B_{23}	0.01	0	0.04	11
B_{24}	0.009	0.002	0.167	6
B_{31}	0.008	0.003	0.268	4

(*continued*)

Table 3. (*continued*)

serial number	D^+	D^-	C	ranking
B_{32}	0.009	0.002	0.165	8
B_{41}	0.009	0.002	0.165	7
B_{42}	0.01	0	0.039	12
B_{43}	0.01	0.001	0.054	10
B_{51}	0.01	0.001	0.114	9
B_{52}	0.011	0	0.028	13

3.4 Service Quality Evaluation

According to the relative closeness of Table 3, the evaluation order of these 14 indicators can be concluded as $B_{12}, B_{11}, B_{13}, B_{31}, B_{21}, B_{24}, B_{41}, B_{32}, B_{51}, B_{43}, B_{23}, B_{42}, B_{52}, B_{22}$. The delivery time ranked the highest, and the staff dress cleanliness ranked the lowest. It can be seen that the service quality of Yunda Express in this region presents obvious differences. The overall evaluation is high. Among the first-level indicators, reliability > professionalism > tangibility > responsiveness > remedial, with remediation ranking the lowest.

4 Conclusions

This paper focuses on the quality of terminal express service of express companies under the background of epidemic. The evaluation model is established. AHP method was used to determine the weight and TOPSIS method was used to evaluate and analyze. This article can be explained from two aspects of theoretical and practical significance:

(1) Theoretical significance
Under the background of the epidemic, the research on the service quality of terminal express has a very positive significance for improving the relevant logistics theory.
(2) Practical significance
It can provide powerful theory and data explanation for terminal express management when they participate in the decision-making of the company. This can be a reference for similar companies to improve the level of service quality.

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