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A study of courier service quality improvement based on a two-stage QFD

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Abstract: In order to reduce the subjective bias and blindness in express service quality improvement process, a new method has been proposed by comprehensively using PZB model, two-stage QFD and fuzzy set theory. In order to establish the two-phase QFD, the related factors for service quality improvement are abstracted along with the PZB model. Through the two-phase transformation of QFD method, express service demand can be transformed into the express service resources. Through the market research, the relative weight of each demand will be determined. Meanwhile, the two quality of house relation matrix can be determined by experts scoring, and can be described quantitatively by using the asymmetric triangular fuzzy number. According to the calculated weight of the express service resources, we can get the modified house of quality. At last, the presented method will be tested through examples.

Keywords: Express Service Quality, Two-stage QFD, Triangular Fuzzy Numbers

1. Introduction

Express delivery in China has developed rapidly along with the electronic commerce development. However, express delivery service cannot meet the explosive customer demand in many aspects. Therefore, the services should change from developing simply and extensively into considering the industry strategic plan, thus satisfying the customer demand.

In recent years, with researching QFD (Quality Function development) in depth, scholars have begun using QFD for service quality improvement. Ermer and Kniper designed three-stage conversion method for the idea of the dynamic development of the QFD theory; Zhang ShuShan etc introduced QFD theory

into logistics service capacity design field, and they also established the dynamic quality function deployment model based on the house of quality and linear programming model. The research focused on determining the customer requirements. Sun Hong put the QFD method into customer satisfaction study, and established the customer satisfaction assessment house of quality model. Through the multi-stage of QFD model, the abstract customer satisfactions have been gradually developed into indexes which are easy for judging, and then can be implemented into an evaluation of customer satisfaction index.

Combining with PZB model, Liang Wenbin has come up with the four-phase QFD model of the service industry. However, this model has too many indexes, which are mainly qualitative indexes. The whole process is too complex to be put into practice. Wang Haiyang put forward the house of quality of the third party logistics services as the customer demand and the improvement measures. This method is concise, but it is subjective and lacks comprehensive consideration of the whole logistics enterprise.

In short, the problems of the research are 1) most indicators of QoH (Quality of House, QoH) are qualitative indicator; 2) extraction and classification of user demand and engineering characteristics of indicators are subjective and arbitrary; 3) the reliability of the relation matrix need to be discussed, which may reduce the objectivity of the decision-making. Therefore, this paper has studied the application of QFD in the courier service industry. Combined with the PZB service quality model, the QFD waterfall decomposition idea and the actual situation in express industry, we have proposed a two-stage model of QoH. By researching the matrix of courier service demand and the capacity of express delivery services, and the matrix of courier services and courier services resource matrix, a new method has been proposed to meet customer demand and to improve the express delivery service quality. The first stage of the QFD research can effectively reduce and even eliminate the gap between internal enterprise and external enterprise, namely Gap 1 in the PZB model; the second stage of the QFD research can effectively reduce and even eliminate the negatively influencing factors in service of internal enterprise, namely the Gap 2, Gap 3 and Gap 4 in the PZB model. This two-stage QFD model, which has been considered more comprehensively, can remarkably quantify the final service resources indicators. The indexes in the step-by-step hierarchy structure can be connected closely. Aiming to the overall satisfaction, the structure will achieve a higher effectiveness.

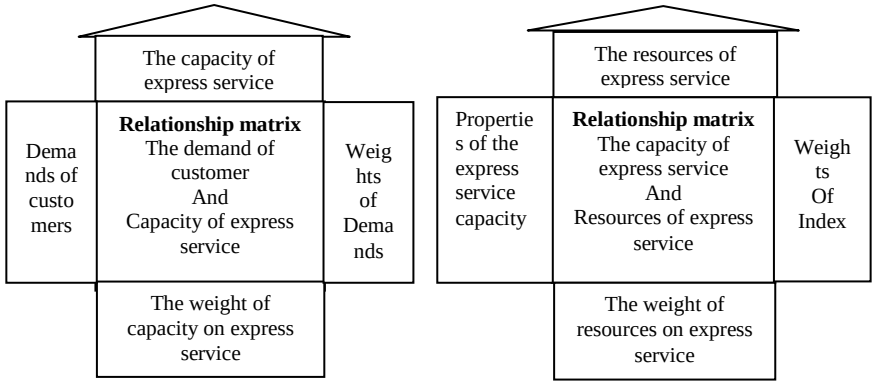

Fig.1. Two-stage QFD Structure

2. The method in this paper

The difficulties of the HoQ are how to determine the relationship between the customer requirements and engineering properties. In the process of QFD, there are a lot of subjective, uncertain and fuzzy expressions. In order to converse the user demand into express service resources, we must transform the fuzzy expressions into quantitative descriptions. To solve the above problems, this paper will use the asymmetric triangular fuzzy number to describe the expert evaluation of relation matrix.

The following mathematical symbols are used in this paper:

Xi—the requirement of the customer of order i, xi is its weight, i=1，2，3，…，L；

Yj—the express service ability of order j, $\tilde{Y}_j$ is its weight, j=1，2，3，… M；

Zk—the express service resource of order k, $\tilde{Z}_k$ is its weight, k=1，2，3，…，N；

$\tilde{R}_{i,j}$ —The correlation between Xi and Yj;

—The correlation between Yj and Zk.

In the above symbols $\tilde{Y}_j$, $\tilde{Z}_k$, $\tilde{R}_{i,j}$, $\tilde{R}_{j,k}$ are fuzzy set. In this paper, we use triangular fuzzy number to represent them. We use $\tilde{f}$ to represent fuzzy set.

(fl，fm，fr) are $\tilde{f}$ Triangular fuzzy number. $(f)_\alpha^U$ and $(f)_\alpha^L$ represent the upper and the lower number of $\tilde{f}$ in different α-cut levels. α is a decimal between 0 and 1.Follows are some public basic formula:

$$(a, b, c) = \sum_{q=1}^{D} d_q(a_q, b_q, c_q) \tag{1}$$

$$(f)_\alpha^U = f_r - \alpha(f_r - f_m) \tag{2}$$

$$(f)_\alpha^L = f_l + \alpha(f_m - f_l) \tag{3}$$

Formula (1) calculates the final score of object. In this formula, (a_q, b_q, c_q) is the Triangular fuzzy number way to show score evaluated by expert 'q'. dq is the expert's weight. (a, b, c) are final scores. $\tilde{R}_{i,j}$, $\tilde{R}_{j,k}$ will be worked out by formula (1). Formula (2) (3) are the upper and lower number fuzzy set $\tilde{f}$ in different α-cut levels. $(R_{i,j})_\alpha^L$, $(R_{i,j})_\alpha^U$, $(R_{j,k})_\alpha^L$, $(R_{j,k})_\alpha^U$ will be worked out by these formula.

The weight of Yj in the α-cut level upper and lower limit is determined by the weight of Xi and the correlation between Xi and Yj. The formulas are:

$$(Y_j)_\alpha^L = \sum_{i=1}^{L} X_i (R_{i,j})_\alpha^L \tag{4}$$

$$(Y_j)_\alpha^U = \sum_{i=1}^{L} X_i (R_{i,j})_\alpha^U \tag{5}$$

The weight of Zk is determined by the weight of Yj and the relationship between Yj and Zk. Since $\tilde{Y}_j$ is Triangular fuzzy number. The formulas are:

$$(Z_k)_\alpha^L = \frac{\sum_{i=1}^{M} (Y_j)_\alpha^L (R_{j,k})_\alpha^L}{\sum_{i=1}^{M} (Y_j)_\alpha^U} \tag{6}$$

$$(Z_k)_\alpha^U = \frac{\sum_{i=1}^{M} (Y_j)_\alpha^U (R_{j,k})_\alpha^U}{\sum_{i=1}^{M} (Y_j)_\alpha^L} \tag{7}$$

Cut sets α, calculated by formula (6) (7), is a Precise interval value $\left[(Z_k)_\alpha^L, (Z_k)_\alpha^U\right]$. Since membership function is unknown, in this paper, using the defuzzification method of average level sets:

$$(Z_k)_{ACL} = \frac{1}{H} \sum_{i=1}^{H} \left(\frac{(Z_k)_{\alpha_i}^L + (Z_k)_{\alpha_i}^U}{2}\right) \tag{8}$$

In this formula $\alpha_1, \alpha_2, ..., \alpha_H$ are different levels of a cut set. They meet the conditions $\alpha_1 \prec \alpha_2 \prec ... \prec \alpha_H = 1$. By formula (8) calculation of Zk different α sets to fuzzy value. The sorting of Express service resource depend on its value.

3. Example analysis

This article considers the whole courier service industry as the research object and concludes 5 customer requirements and their weights, 6 courier service capacity factors and 8 courier service resource indicators by referring to the courier complaints statistics issued by the State Post Bureau and the research from other scholars. The meanings of each letter symbol are as follows:

Customer requirements: X1, On-Time Delivery; X2, Good Service Attitude; X3, Good Express Condition; X4, Reasonable and Formal Charges; X5, Complete Information. Weight: x1 = 0.516, x2 = 0.215, x3 = 0.240, x4= 0.017, x5 = 0.012.

Courier service capacity factors: Y1, Transport Capacity, Y2, Sorting Capacity, Y3, Distribution Capacity, Y4, The Organization and Management Ability, Y5, Innovation Capability, Y6, IT Capacity.

Courier service resource indicators: this article considers four factors: Human Resources, Material Resources, Financial Resources and Knowledge Resources.

Human Resources include (Z1) express business management personnel and (Z2) first line operators (including sorters, dispatchers, etc.). Material resources include hard resources and soft resources. Hard resources refer to (Z3) infrastructure, equipment (such as collecting and distributing centers, warehouses, transportation vehicles, loading and unloading machines, computers, communications equipment, etc.), (Z4) distribution networks (such as courier companies receiving outlets, the scope of the express network radiation, transport corridors, etc.) which all support the service of express delivery companies. Soft resources include (Z5) IT (such as information systems, customer service centers, etc.). Financial resources include the own funds of the enterprises (Z6) and the financing channels for enterprises. Knowledge resources include management resources and organizational resources. Management resources refer to (Z7) management system, concepts, methods of the express company; organizational resources refer to (Z8) organizational structure and business processes of the express company.

The degree of independent in the relationship matrix is judged by the three experts. In the experiment, there are five levels: very low (VL), low (L), Medium (M) and high (H), very high (VH) and the corresponding triangular fuzzy number are (0,0, 0.2), (0,0.2,0.4), (0.3,0.5,0.7), (0.6,0.8,1) (0.8,1,1) in turn; experts score them by selecting the appropriate levels. Considering the professional standards and management experience, the weight of three experts, are: 0.2, 0.5, and 0.3. The relational matrix of X-Y and the matrix of Y-Z can be calculated by the formula (1). Upper and lower limits of different levels of α cut

set can be obtained from formula (2) (3) (4) (5). Combined with formula (6), (7), we can obtain the weight of Zk.

The fuzzy value of each courier service resources can be calculated by formula (8), and then can be sorted by their sizes, as shown in Table 1. By using results of this model, we can re-allocate and improve the express service resources, thus the service will meet the customer demand for maximum efficiency.

Table1. The customer demand and express service ability fuzzy correlation

Express service resources	$(Z_k)_{ACL}$	Order
Express enterprise management personnel	0.784	5
First line operation personnel	0.761	6
Infrastructure equipment	0.797	4
Distribution network	0.854	3
Information technology	0.894	2
Enterprise from its own funds and financing channels	0.668	8
Enterprise management concept	0.695	7
Enterprise organization structure and business processes	0.903	1

4. Conclusion

This paper firstly extracted the service quality improvement of related reasons from the application PZB model, in order to establish the two stage QFD model. Through QFD method and the two phase transformation, the express service needs have been altered into the express service resources which are closely contacted with the service. In this paper, we have used the market research to determine the relative weight of each demand, have assumed the expert scoring to determine the two quality-of-house relational matrixes, and have quantitatively described asymmetric triangular fuzzy number for the calculation of the weights of the express service resources. Finally the example demonstrated the validity of the proposed method.

Classic QFD method is a kind of customer demand actuation product design method. This paper applies this method to the study of customer demand satisfaction in the express industry and adapts this method to the whole service industry. By combining PZB model, we proposed two-stage house of quality model, which is more accessible and more convincible. Therefore, the method can help to enhance the scientific, objectivity and accuracy of the service quality improvement methods, and has strong applicable value. The method proposed by this paper is not only available to analyze the whole express industry but also can be combined to some certain express companies, which is more practical and valuable.

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