Scientific Research

Analysis of Logistics Service Attributes Based on Quantitative Kano Model: A Case Study of Express Delivering Industries in China

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ABSTRACT

Considering the non-linear relationship between product attributes and customer satisfaction, Kano's model is widely used in the area of quality management and product innovation. In order to address the deficiencies of traditional Kano method in qualitative analysis and subjective classification criteria, a quantitative Kano model is set up. By the building of Kano Quantitative satisfaction index and importance index, an objective classification method and the decision-making rule to improve service quality are proposed. Then a well-established logistics service attributes analysis model based on quantitative Kano model has come up. The model is illustrated through a case study of express delivering industries in China.

1. Introduction

Based on Herzberg's 'Motivator-Hygiene Theory', Kano *et al.* (1984) defined the product quality element of different categories that impact customer satisfaction in different ways. Which namely: attractive quality attribute, must-be quality attribute, one-dimensional quality attribute, indifferent quality attribute and reverse quality attribute [1]. Using Kano's model, quality attributes that have the greatest influence on customer satisfaction can therefore be identified, and these can then be used to focus on priorities for product or service development and improvement [2]. With such advantage, Kano model is widely used in quality management [3], new product development [4-6] as well as QFD integration [7-9].

Using Kano model to analyze product or service attribute, we can consider both customer psychology elements and customers' consume motivation, witch can make up the flaw of the data mining tool, because applying a data mining technique in capturing customer knowledge is done by collecting and tracking lots of transacttional data only to obtain purchasing behavior knowledge about customers.

The Kano diagram provides a rough sketch of the customer's satisfaction in relation to the product and service performance level. In such a sense, it only allows quailtative assessment of product and service attributes [10], and the resulting Kano category is still qualitative in nature, which could not precisely reflect the extent to which the customers are satisfied [11]. these limitations make it fall short to play a key decision-making role in product innovation and service management. Therefore, Berger *et al.* (1993) proposed a graphical Kano diagram that is based on predefined scales related to the customer's satisfaction and dissatisfaction. Each customer requirement can be represented as a pair of satisfaction and dissatisfaction values [11]. Yang,Ching-Chow (2005) redefined the Kano model by integrating the analysis of the importance-satisfaction(I-S model), and the classified result of Kano model was redefined from four kinds to eight kinds [3]. Considering the customer sensation fuzziness towards the product or service attribute, Yu-Cheng Lee, Sheng-Yen Huang (2009) proposed a kind of fuzzy Kano model design concept [12].

2. Kano Model

According to different types of relationship between quality attributes and customer satisfaction, Product quality elements are classified into attractive quality elements, one-dimensional quality elements, must-be quality ele-

ments, indifferent quality elements, and reverse quality elements using Kano's model [1]. Kano model is illustrated in **Figure 1**.

- Attractive quality element: its full functionality will definitely incur customers' satisfaction; however, dissatisfaction will not be sensed if absent.
- One-dimensional quality element: customer satisfaction is proportional to the degree of its function fulfillment. It is a normal requirement of customer demands, where the higher the product functionality quality, the higher customer satisfaction will be.
- Must-be quality element: customer takes its full functionality for granted; failing to fulfill the function certainly provokes strong customer dissatisfaction; however, its presence increases no satisfaction.
- Indifferent quality element: Customer does not matter whether it is functional or not.
- Reverse quality element: Customer is dissatisfied when it is functional, satisfied when it is not functional.

For better customer satisfaction and less customer dissatisfaction, a company has to make every effort to offer attractive quality elements in new products as well as eliminate possible defects on must-be quality elements. Because the judgment of attractive quality or must-be quality is highly personal, it is tacit knowledge embedded in customers' mind. Scholars also pointed out that must-be quality elements are normally less implicit, while attractive quality elements are hidden, implicit, so it is desirable for a company to take the hypothesis-testing approach to survey the market. Therefore, for a company, the most important task is how to survey the customers in the market to excavate all the implicit customers' knowledge and convert them into explicit customer knowledge
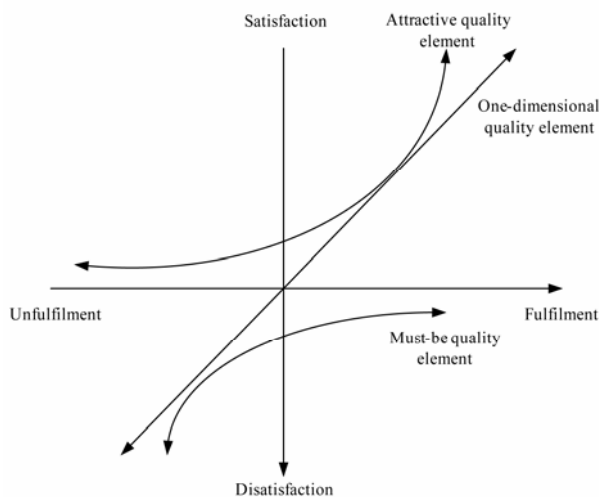

Figure 1. Kano model of quality attributes.

that can be transformed into a successful product.

3. Design of Quantitative Kano Model

Matzler *et al.* (1998) pointed out that the convenient way to quantify Kano model is to evaluate the customers' satisfied or dissatisfied level towards products or service performance [2]. That means to design customers' satisfaction scale of positive or negative problems towards products or service attributes as showed in **Table 1**. Because the positive answer is stronger than the negative answer, the asymmetry scale is designed to reduce the impact of negative evaluation [13].

In addition, the traditional Kano model doesn't consider the customers' importance perception towards each product or service attribute. Combined with Yang's research results [3], we can integrate customers' importance perception in the questionnaire. The specific scale is showed in **Table 2**.

If a product or service attribute expressed as $F = \{f_i | i = 1, 2, \cdots, I\}$, F is the product or service attribute set, f_i is the i th product or service attribute, J is the total amount of the interviewed customers, according to the re-design Kano questionnaire, we can get customers' evaluation towards each product or service attribute $f_i = (\forall i = 1, 2, \cdots, I)$:

$$e_{ij} = (x_{ij}, y_{ij}, w_{ij}) \tag{1}$$

Among them, x_{ij} is the j th customer's evaluation towards the negative problem of product or service attribute f_i; y_{ij} is the j th customer's evaluation towards the positive problem of product or service attribute f_i; w_{ij} is the j th customer's importance evaluation towards the product or service attribute f_i.

For each product or service attribute f_i, customers' average satisfaction level towards the negative problem is defined as $\overline{X}_i$; customers' average satisfaction level towards the positive problem is defined as $\overline{Y}_i$, so there are:

$$\overline{Y}_i = \frac{1}{J} \sum_{j=1}^{J} w_{ij} y_{ij}, \quad \overline{X}_i = \frac{1}{J} \sum_{j=1}^{J} w_{ij} x_{ij} \tag{2}$$

The value of $(\overline{X}_i, \overline{Y}_i)$ can trace in the two-dimensional coordinates chart, the horizontal dimension is the customers' dissatisfaction degree towards product or service attribute f_i and the vertical dimension is the satisfaction degree. Most $(\overline{X}_i, \overline{Y}_i)$ should be in the range of 0-1, the negative value is the reverse quality factors or the questionable answer which shouldn't be included in the calculation of the average value. So the product or service attributes f_i can be described as a vector, namely $r_i \equiv (r_i, \alpha_i)$, where, $|r_i| = \sqrt{\overline{X}_i^2 + \overline{Y}_i^2}$,

Table 1. Satisfaction scale of positive or negative problems.

		I like it very much	It must be this way	I am neutral	I can live with it	I don't like it
Product or service attribute	With the attribute	1	0.5	0	−0.25	-0.5
	Without the attribute	−0.5	−0.25	0	0.5	1

Table 2. Importance scale.

Unimportant	Somewhat important	Important	Very important	Extremely important
0-0.2	0.2-0.4	0.4-0.6	0.6-0.8	0.8-1.0

$\alpha_i = \tan^{-1}\left(\overline{Y_i}/\overline{X_i}\right)$.

We called the distance of vector (r_i) as Kano importance index, $0 \le |r_i| \le \sqrt{2}$. Angle (α_i) is called as Kano satisfaction index, $0 \le \alpha_i \le \pi/2$. If we use Kano satisfaction index and Kano importance index as two dimensions, the domain of product or service attributes can be divided into four quadrants. According to different level of satisfaction degree and importance degree, we can propose the improvement decision-making rule for a product or service attribute specifically. And this will be illustrated through a case study of express delivering industries in China.

4. Detection Process of Logistics Service Based on the Quantitative Kano Model

Along with the economy developed rapidly, logistics enterprises in China face many challenges which customers require to improve logistics service quality fast. Therefore, it is necessary for these enterprises to make the proper logistics service strategic plan based on the service design orientation. Some scholars studied the problem about the design and plan of logistics service capacity with QFD [14-15] and other scholars studied the optimized problem of logistics service with fault tree [16]. These researches played an important role in improving logistics services. Considering that with Kano model to detect product or service attribute, we can integrate customer psychological factors and customers' consume motives, so we will analyze the logistics service attributes for quality improvement based on quantitative Kano model.

The purpose to analyze logistics service attributes is to identify the key component elements of logistics service from customer perspective as well as the priority of these attributes in the decision-making for quality improvement. Based on the customer survey data, combined with the classified criterion of customer satisfaction factors of quantitative Kano model, the concrete classified results

of logistics service attributes cab be gained. And if we use Kano satisfaction index and Kano importance index as two dimensions, we can find out the priorities of these attributes. The detection process of logistics service based on the quantitative Kano model is showed in **Figure 2**.

4.1. Attributes Distinction of Logistics Service

Woodruff proposed that customer value of products or service is the customers' sensation preference and appraisal towards the product or the service attribute and the attribute potency as well as achieving the purpose by the using result. In other words, the customer value is a spatial structure which includes three levels: the service attribute, the service effect and the using result. The connection of these three levels constitutes a way — means-end chain. From bottom to up, attribute is the method to achieve the effect, the effect is the method to achieve customer goal, vice versa.

In the bottom of the model, customers regard the service as the coalition of specific attribute. They will form a kind of expectation and preference which is the value they want to own reflecting in customer value according to the contribution of specific service attribute to realizing the expectation result when they purchase and enjoy the service. Meanwhile, customers can achieve their own goal according to the service attributes and form the expectation of the specific using results. Satisfaction degree can be produced in each level of customer's expectation value level model, and the total satisfaction degree is decided by the sum of customer satisfaction degree in different levels.

Therefore, the enterprise should distinguish the benefits that the logistics service brings to customers according to the customers' perceive value towards the attributes, characteristics and the functions of a latent logistics service when any item logistics service concept is put forward. The logistics enterprise can adopt the analysis method of means-end chain to analyze each logistics service to distinguish the key elements that compose the
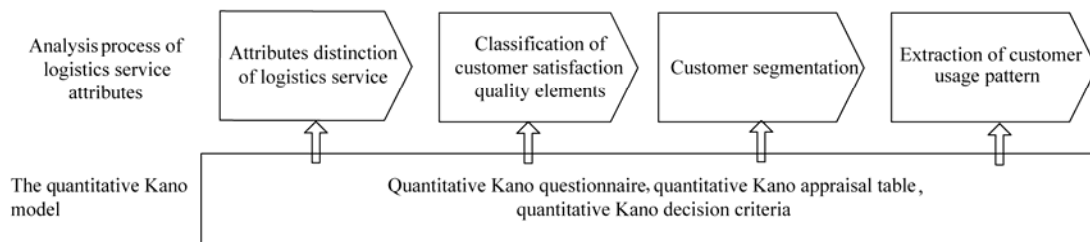
Figure 2. Analysis process of logistics service attributes based on quantitative Kano model.

logistics service through the service attributes, the customer using result as well as customer's ultimate objecttive by the bidirectional communication with customers and form many attributes of logistics service, then the Kano questionnaire of logistics service attribute can be designed. The customers can make the response according to the benefits that are brought by these logistics service attribute. When these customers' attitudes towards service are collected by data form, the enterprise gains the customer knowledge about the customer preference to logistics service.

4.2. Classification of Customer Satisfaction Quality Elements

Through integrating the Kano questionnaire for "human data" with a conventional interval rating scale survey instrument for 'transaction data' to collecting primary data, customers' preferences to a logistics service attribute can be understood. In every questionnaire, an individual customer presents his/her own specific preference pattern, his/her demographic data, and the monetary value he/she is willing to pay for certain logistics service features. The aggregate of questionnaires by all sample customers constitutes the database for Kano's Method to realize customer satisfaction clues' categorization in terms of attractive, must-be, one-dimensional, indifferent, and reverse quality elements. At this stage, the company acquires knowledge 'about' customers by understanding customers' background, expectation, and preference on logistics service attributes.

4.3. Customer Segmentation

Customer segmentation refers to the process that the enterprise divides a whole service market into some certain customer groups, according to differences of customers' demands and desires, purchase behaviors or customer value. According to Kotler's marketing theory, the enterprise is changed from be organized based on the product units to be organized based on customer segments. He proposed the market can be divided according to two variables [17]: 1) customer characteristics, such as geography characteristics, population statistic character-

istics and psychological variables and so on; 2) behavior variables, such as customer attitudes about service, customer responses about benefits so on. Using the data gained from the sub-process of "customer satisfaction classification" to do the correct market segmentation based on the related customer characteristics. After the segmentation, the concrete characteristics of each customer group can be distinguished and service attributes classification from different customer groups can be found.

4.4. Extraction of Customer Usage Pattern

Once the customer segmentation task is done, the attracttive quality element, must-be quality element, etc, for that segment of customers, are also determined by Kano's Method to delineate the prospective customer usage patterns in each segment. Therefore, the knowledge from customers supports the logistics company to serve the right market segments and make appropriate strategic business decisions in the logistics service development plan and marketing activities. By a prospective customer usage pattern extracted from the aggregate customer sample, a company may revise the original logistics service's definition and set priorities for service attributes to be developed, enhance the functionality of the attractive quality element, ensure no defect on the must-be quality element, improve the performance of the must-be quality element, and rule out service attributes categorized as reverse and indifferent quality elements. Market segmentation also provides further insight for the perspective usage pattern in each segment. The differentiated pattern demonstrated by different segments also becomes useful information for a logistics company to take the right tactics for improve service quality to satisfy various segments.

5. Case Study

With the development of economics in China, many enterprises and people are desired high logistics service quality of express delivery industries. But few people are satisfied to service quality of the express delivery Industries. So it is critical to acquire customer knowledge to

aid in express delivery service planning and conducted a pilot market survey introducing the quantitative Kano model. In this project a hybrid questionnaire combining Kano's method with a conventional interval ratings scale instrument was created to extract customer knowledge. Based on the survey of many Chinese express delivering industries and we get some representative express service attributes as shown in **Table 3**. And **Table 3** also describes the relationship between the each of the benefits that provide for customers.

5.1. Design of Kano Questionnaires

The first part of the questionnaire is related to demographic characteristics of customer-related information. The second part of the questionnaire is the survey of express service-related attributes, a total of 26 pairs of entries, and each entry is designed according to the form shown in **Table 1**. The upper row is the positive problem part of Kano questionnaire, while the lower row is the negative problem part of Kano questionnaire. The ques-

Table 3. Express service attributes and the benefits it provides.

Service attributes	Description of logistics service attributes	Benefit provided for customers
f_1	Arrive today by air (before 22:00 of today)	fast
f_2	Arrive today by land (before 22:00 of today)	fast
f_3	Arrive next day	fast
f_4	Keep 7 days free for the goods that isn't delivered	safe, convenient
f_5	Service for 365 days	convenient
f_6	Realize man-made, self-orders, express item inquiry and other functions through call center	convenient, fast
f_7	Collection payment for arrived cargo (free)	safe, convenient
f_8	Value insured service (5‰ of the statement value)	Convenient, value-added
f_9	Delivery after noticed	convenient, timely
f_{10}	Night pick-up service	convenient
f_{11}	Write commission	safe
f_{12}	MSG short message notification	convenient, safe
f_{13}	Packing service	value-added, safe
f_{14}	Self-check	convenient
f_{15}	Delivery staff with friendly attitude and professional	cheerful, convenient
f_{16}	Delivery staff is familiar with the company philosophy	cheerful, safe
f_{17}	Delivery staff dress clean and tidy uniform	cheerful
f_{18}	Brand trust, a sense of security	safe
f_{19}	Expand the related business positively and rapidly	convenient, fast
f_{20}	Free delivery documents	beneficial
f_{21}	Complete appointment orders and pick within 1 hour	fast
f_{22}	Complete in 2 hours from arriving the shop to deliver	fast, safe
f_{23}	Pick up time appointment with telephone	convenient
f_{24}	Customers can pick up the goods himself in an uncover network region	Increase customer cost
f_{25}	Communicate easily with a delivery staff	cheerful, convenient
f_{26}	Communicate easily with a call center staff	cheerful, convenient

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tionnaire integrates the Kano questionnaire survey methods and traditional 5 scale survey methods.

Table 4 is quality factors classification of Kano model in which "A" represents attractive quality attribute, "O" represents one-dimensional quality attribute, "R" represents reverse quality attribute, "M" represents must-be quality attribute, "I" represents indifferent quality attribute. "Q" represents questionable answer.

5.2. Data Collection

The respondents were selected randomly to do a survey from an express company's customers, and the survey was conducted in two forms: E-mail and face to face survey. 130 questionnaires were distributed; the period is from May 1, 2010 to May 31, 2010. And finally, 87 questionnaires were recovered, 83 questionnaires were available, the effective questionnaires response rate was 63.8%, the specific sample characteristics are in **Table 5**.

5.3. Date Analysis

Based on the quantitative Kano model, statistical results are shown in **Table 5**. In order to detect the category of the express quality service attribute, supposing the value of importance indicators is 0.5, for service attribution f_i, if $x_i < 0.5$ and $y_i < 0.5$, f_i is considered unimportant and divided into indifferent quality; and if $x_i \geq 0.5$ and $y_i < 0.5$, f_i is considered as must-be quality. Similarly, if $x_i \geq 0.5$ and $y_i \geq 0.5$, f_i is thought to be one-dimensional quality; if $x_i \leq 0.5$ and $y_i \geq 0.5$, f_i is called as the attractive quality. This can be shown in **Figure 3**. **Table 6** is the final classification results of express service attributes.

5.4. The Findings and Discussions

For the aggregate customers, **Table 6** shows that the two express delivery service: service for 365 days and MSG short message notification are regarded as attractive quality elements, it shows that the aggregate customers would be delighted by these two service attributes. The customer aggregate also prefers more functionality on items such as delivery after noticed, communicating easily with a delivery staff and other 5 service as these items are regarded as must-be quality elements. And arriving today by land, arriving next day, express items inquiring, other functions realized through call center and other 12 service attributes are regarded as must-be quality elements. Meanwhile, arriving today by air, collection payment, delivery staff is familiar with the company philosophy and other 7 service attributes are perceived as indifferent quality.

Customers in different segments do demonstrate a differentiated perspective usage pattern. For example, self-check and CTI synthesis information service system and other service attribute are perceived as attractive quality elements by college students. The segment consists of many young college students customers who show a strong propensity to appreciate specific features such as internet web browsing. And the service attributes such as arrive today by land, delivery after noticed, delivery quickly after express mail arrive at outlets and communicate easily with a call center staff are perceived as must-be quality elements by both individual workers and state owned enterprise customers, but these service attributes are perceived as different quality elements by college students and private enterprise customers. It can be found that individual workers and state owned enterprise customers attach more attention to their professionalism and safety when they use the express delivery services. One important reason is that these two customer groups often express some relatively expensive items (such as the company contracts, invoices, receipts of goods, etc.).

The knowledge 'from' customers in different market segments discovered through Kano's Method becomes a valuable asset for an express delivery company to deploy further its detailed business strategies to precisely target those market segments for greater marketing accomplishments.

Table 4. Quality attributes categories of Kano model.

		With the service attribute				
		like	Must-be	neutral	Live with	dislike
Without the service attribute	like	Q	R	R	R	R
	Must-be	A	I	I	I	R
	neutral	A	I	I	I	R
	Live with	A	I	I	I	R
	dislike	O	M	M	M	Q

Table 5. Perception that expressed by customers for service attributes.

Service attributes	College students (36)		individual workers (22)		Private Enterprise (13)		State Owned Enterprise (12)		Overall (83)	
	$\overline{X}_i$	$\overline{Y}_i$	$\overline{X}_i$	$\overline{Y}_i$	$\overline{X}_i$	$\overline{Y}_i$	$\overline{X}_i$	$\overline{Y}_i$	$\overline{X}_i$	$\overline{Y}_i$
f_1	0.1625	−0.0065*	0.1052	0.4510	0.3437	0.2260	0.8062	0.4485	0.0990	0.0388
f_2	0.1313	−0.0125*	0.3471	0.4472	0.0761	0.2023	0.8826	0.3649	0.9128	0.2646
f_3	0.4063	0.5375	0.6019	0.0886	−0.0753*	0.3820	0.8161	0.4793	0.8365	0.4713
f_4	0.5500	0.4750	0.5134	0.3478	0.0817	0.4890	0.6443	0.2217	0.7966	0.4050
f_5	0.4375	0.2813	0.1297	0.9069	0.4430	0.7846	0.2676	0.5404	0.0936	0.5700
f_6	0.4000	0.5500	0.5340	0.7273	0.2510	0.1358	0.7823	−0.1005*	0.7176	0.1958
f_7	−0.0188 *	0.0063	0.4700	0.4785	0.3066	−0.0722*	0.5862	0.6791	0.4759	0.2297
f_8	−0.0125*	0.0500	0.2802	0.0977	0.5415	0.7035	0.9419	0.3877	0.1430	0.1832
f_9	−0.0313*	0.0500	0.9238	0.8625	0.0268	0.1872	0.8809	0.6731	0.6221	0.6063
f_{10}	−0.0224*	0.0500	0.2570	0.3615	0.0334	0.2412	0.7529	0.1163	0.0527	0.2199
f_{11}	−0.0115*	0.0457	0.8022	−0.0389*	0.6049	0.3714	0.6984	0.0004	0.9130	0.0789
f_{12}	0.4550	0.5765	0.3401	0.9771	0.3403	0.6165	0.1213	0.9115	0.3662	0.6495
f_{13}	0.5565	0.4575	0.5382	0.8813	0.7262	0.6599	0.9447	0.1928	0.6072	0.4535
f_{14}	0.4550	0.5765	0.1252	0.8442	0.2680	0.5110	0.5765	0.3557	0.6863	0.2648
f_{15}	0.5565	0.8576	0.6768	0.8494	0.7890	0.8050	0.8326	0.9725	0.9405	0.6767
f_{16}	0.1030	0.0298	0.1812	0.4851	0.2495	0.3865	0.2137	0.3714	0.4579	0.2660
f_{17}	0.7186	0.3345	0.7976	0.2538	0.6148	0.0690	0.6969	0.3724	0.5118	0.1242
f_{18}	0.8295	0.2266	0.6950	0.0403	0.5002	0.1324	0.9233	0.3685	0.9581	0.0614
f_{19}	0.1467	0.0347	0.5500	0.7116	0.1805	0.1776	0.8426	0.6239	0.8164	0.5788
f_{20}	0.8018	0.4451	0.8524	0.0041	0.5064	0.0999	0.5321	0.2902	0.6589	0.2520
f_{21}	0.6236	0.6709	0.8166	0.6448	0.5890	0.9993	0.6840	0.2326	0.5543	0.5201
f_{22}	0.1420	0.0975	0.9334	0.3484	0.8971	0.9437	0.5320	0.3416	0.5745	0.1690
f_{23}	0.2438	0.0855	0.1191	0.4434	0.3378	0.3274	0.0783	0.0145	0.4713	0.2180
f_{24}	0.4777	0.3472	0.4928	0.3844	0.2053	0.2580	0.2814	0.4180	0.2116	0.1551
f_{25}	0.6748	0.6672	0.5401	0.9542	0.9792	0.9652	0.9440	0.7146	0.8227	0.5723
f_{26}	0.3665	0.1837	0.7527	0.0436	0.4418	0.1603	0.8192	0.3007	0.7148	0.1346

*Negative value refers to the reverse quality or questionable answer

To further detecting the priority of service attributes and providing effective service management decision-making for logistics enterprise, it necessary to use some Kano index to carry on the analysis. The logistics service attribute domain is divided into four quadrants based on two dimensions: Kano satisfaction index and Kano importance index. The horizontal dimension shows the degree of satisfaction of a quality attribute, and the vertical dimension shows the importance level of the quality attribute. As shown in **Figure 3**, r is the average of the importance index of all the express service attributes and α is the average of the satisfaction index. According to different levels of satisfaction and importance, targeted services management decisions are proposed.

For quadrant Ⅰ, it is known as the "Care-free" area. Customers' perception of satisfaction index and impor-

Table 6. Discovery of different customer groups' knowledge.

Service attributes	College students (36)	Individual workers (22)	Private Enterprise (13)	State Owned Enterprise (12)	Overall (83)
f_1	I	I	I	M	I
f_2	I	M	I	M	M
f_3	I	M	M	M	M
f_4	I	M	A	M	M
f_5	A	A	A	A	A
f_6	A	A	I	M	M
f_7	I	I	I	M	I
f_8	I	I	I	M	I
f_9	I	O	I	O	O
f_{10}	I	I	I	M	I
f_{11}	M	M	M	M	M
f_{12}	I	A	I	A	A
f_{13}	O	O	O	M	M
f_{14}	A	A	I	M	M
f_{15}	O	M	O	M	O
f_{16}	I	I	I	I	I
f_{17}	M	M	M	M	M
f_{18}	M	M	M	M	M
f_{19}	I	O	I	O	O
f_{20}	M	M	M	M	M
f_{21}	O	O	O	M	O
f_{22}	I	M	I	M	M
f_{23}	I	I	I	I	I
f_{24}	I	I	I	I	I
f_{25}	O	O	O	O	O
f_{26}	I	M	I	M	M

tance index towards service attributes in this region is not high. So the enterprises do not need to spend more resources to focus and improve these service attributes. As can be seen from **Figure 2**, the service attributes f_8, f_{17}, f_{22} is in this area, and f_8 is also an indifferent quality element, so the enterprise does not need to care about the service attribute f_8.

For quadrant Ⅱ, it is called "Surplus" area. Customers' perception of satisfaction index is high and perception of importance degree isn't high towards service attributes in this region. If it is necessary to cut service costs, these

are the attributes that can be eliminated without incurring a significant negative impact on the customer satisfaction. Service attributes f_1, f_5, f_7, f_{10}, f_{16}, f_{23}, f_{24} are most of the indifferent quality attributes is in this area. This is consistent with the fact. For the customer, he certainly regards the quality attributes that he does not care about as unimportant quality attributes. However, not all of the indifferent quality elements are in the area.

For quadrant Ⅲ, it is called "Excellent" area. The service attributes located in this area are those that customers considered to be important, and for which the per-
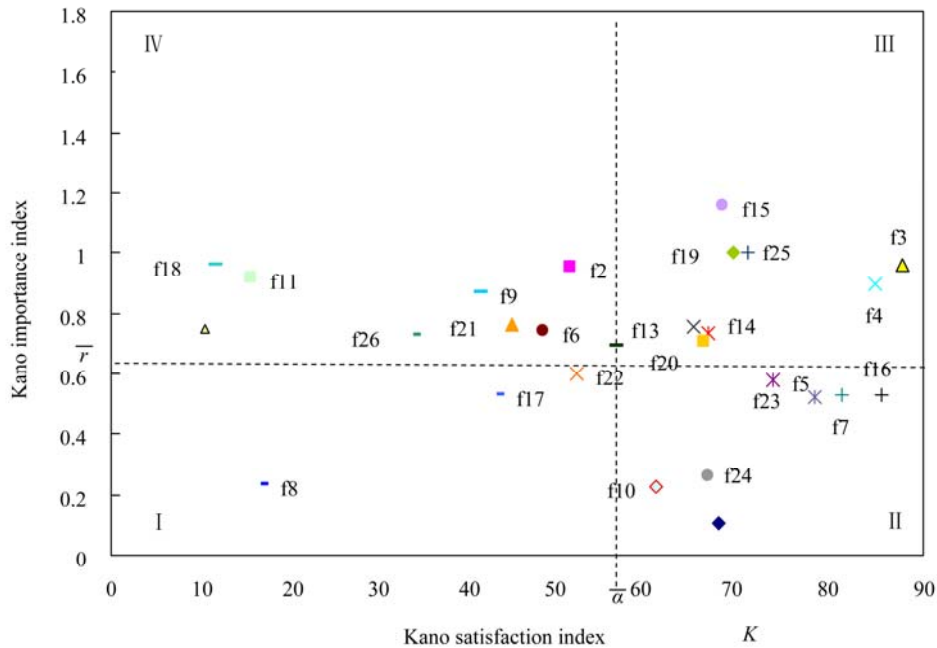
     JSSM

Figure 3. Decision matrix based on the index of quantitative Kano model.

formance is satisfactory to customers. Retention of customers requires that performance in these attributes be continued. From the empirical results, it can be seen that the service attributes $f_3, f_4, f_{13}, f_{14}, f_{15}, f_{19}, f_{20}, f_{25}$ are in the region, most of these service attributes are must-be quality and one-dimensional quality elements.

For quadrant Ⅳ, it is called "to be improved" area. The service quality attributes listed in this area are those considered as important to customers but for which the performances have not met with expectation. The logistics company must focus on these attributes and make improvements immediately. It can be seen from the empirical results that the service attributes $f_2, f_6, f_{13}, f_{18}, f_{26}$, witch perceived as must-be quality elements, f_9, f_{21} witch regarded as one-dimensional quality elements and f_{12} perceived as attractive quality elements are in the region.

6. Conclusions

In order to solve the problems of Kano model's qualitative analysis and subjective classification, a quantitative Kano model is set up. By the building of Kano satisfaction index and importance index, an objective classification method is proposed. Then a logistics service attributes detection model based on quantitative Kano model has been established to identify the attractive quality elements, the must-be quality elements, the one-dimensional quality elements, the indifferent quality elements and the reverse quality elements of logistics ser-

vice attributes. Based on Kano satisfaction index and importance index, the state of logistics service attributes is distinguished and the improvement decision-making criteria of logistics service based on quantitative Kano model are proposed. Enterprises must set up appropriate priorities according to the different service attributes in the process of developing or improving logistics service quality. The quantitative Kano model set up in this article enables logistics enterprises to obtain much more valuable information about customer needs. It is not only a useful practical tool for industries, but it is also a theoretical model for academic research.

There are some shortcomings in the preliminary discussion about the construction problem of the quantitative Kano model, such as the determination of threshold value of classified rule needs to go a step further research, and the resources constraint should be considered on the analysis process of the decision-making of logistics services detection, which will serve as a future direction for future research.

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