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A Proposal to Analyze Customer Psychological Demands based on QFD Incorporating the Concept of the Kano Model

Zhixin Wu[1,2], Liufang Yi[3*]

[1] School of Business Administration, Zhejiang University of Finance & Economics Dongfang College, Jiaxing, 314408, China

[2]School of Business Administration, Zhejiang University of Finance and Economics, Hangzhou, 310018 China

[3]College of public education, Zhejiang Institute of Economics and Trade, Hangzhou, 310018 China,

*Corresponding Author.

Abstract:

The People's physiological and psychological needs form the binary value medium of material and information in generalized virtual economy. In the era of generalized virtual economy, if enterprises want to obtain a lasting competitive advantage, they must pay attention to the psychological needs of customers. However, the psychological needs of clients are changeable. How to obtain the dynamic psychological needs of consumers scientifically, accurately and timely through scientific methods and tools has become the focus of various types of enterprises in the development and innovation of products. In the design process of condenser, the psychological demand information from customers is very important. How to analyze these fuzzy customer psychological demand information has become the key to enterprise innovation. Through the investigation of more than 100 automobile condenser manufacturers in China, this study deeply interviewed more than 200 customers at home and abroad to study the psychological needs of clients. This paper discusses the innovation behavior of enterprises from the perspective of the generalized virtual economy from the perspectives of enterprise technology innovation, service innovation and management innovation. In order to solve the inherent defects in the practical application of traditional QFD, such as the evaluation of the relationship between customer psychological needs and engineering technology, the determination of the weight of customer psychological needs and the prioritization of engineering technology, a QFD method considering customer psychological behavior in a probabilistic language environment is proposed. The initial weight of customers' psychological need is determined by PL-MAHP. According to the relationship between customer psychological need, fuzzy cognitive map (FCM) is used to infer and analyze customer psychological need and obtain its final weight. PLTS is used to characterize the correlation strength between customer psychological need and engineering technology. The influence of customer psychological behavior on the priority of engineering technology is fully considered. Combined with the concept of Kano model, this study proposes a customer psychological needs analysis method based on Quality Function Deployment (QFD). The importance of customers' psychological needs is corrected from the traditional QFD method. Aiming at the traditional Kano model can not effectively reflect the complex and changeable psychological situation of customers, a customer psychological demand classification method based on Fuzzy Kano model is

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constructed. This study uses the application of Kano model and QFD in enterprise product design improvement and innovation to effectively determine the final importance. Compared with other existing methods, it verifies the feasibility, effectiveness and superiority of this method, and achieves ideal results.

Keywords: *The Kano Model, QFD, Parallel Flow Condenser, Customer Psychological Demands*

I. INTRODUCTION

The condenser is the key component of automotive air conditioning. In the development of its design process, the information from the customers is very important. As a matter of fact, this information is fuzzy. Therefore, the analysis of customer information would be the key of condenser manufacturers to survive in the competitive market. Using the quality of planning table of QFD [1] incorporating the concept of the Kano model [2] of the relationship between customer satisfaction and product quality, different customer needs will be further subdivided according to certain principles. For example, excitability is divided into basic needs, aspiration needs, and excitement needs. Then the company draws into a QFD matrix of product planning in order to set the importance of these customer type needs. By adjusting the importance of traditional QFD can reflect more accurately customer needs and satisfaction. Taking into account the Kano model and QFD in their respective advantages, specific implementation, and their shortcomings, this paper will explore on the basis of integration for these two methods and the inadequacy of existing research. Then this paper will seek an effective integration in order to bring into playing their respective advantages and make up for their weak points.

The Kano model can be used so as to enhance the decision support role of QFD. Many researchers have conducted the researches on the integration of these two model. Integration of the Kano model and QFD is mainly necessary for the grasp of customer needs at the quality of planning stage in QFD methodology. In the process of integration, the researchers usually need to address two issues. One is to correspond the customer's request to the quality classification of the Kano model. The other is which element of the Kano model should be mapped to customer requirements efficiently. All rights reserved and systematically without a feeling of strangeness. In achieving a combination of the integration, most researchers directly define the importance of customer needs of QFD based on the quality classification of the Kano model and personal experience. This method is very simple, but obviously, this way is too subjective. Based on the concept of the Kano model, Kurt Matzler and Hans H. Hinterhuber put up the concept of customer satisfaction coefficient and described its role in the process of QFD [3]. But they did not offer the concrete method about the integration of the Kano model and QFD. Kay Chuan Tan, Min Xie, and Xiao-Xiang Shen proposed the approximate transfer function which is used to refine the original improvement rate [4]. This transfer function fixes the improvement rate by multiplied by the original importance of customer needs and gets final importance ratings. Since this function is linear, it does not represent the characteristics of the Kano model. Chih-Hung Hsu, Tsan-Ming Chan, Shih-Yuan Wang, Pei-Yi Lin used non-linear function [5], but the method of determining the importance of customer needs is inefficient. This research on the parallel flow condenser quality optimization leads the better method for the integration of the Kano model and QFD and optimizes the quality of parallel flow condensers by applying the method.

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II. MATERIALS AND METHODS

2.1The KANO and QFD Application Background

Through the investigation of more than 100 automobile condenser manufacturers in China, this study deeply interviewed more than 200 customers at home and abroad to study the psychological needs of clients. This paper discusses the innovation behavior of enterprises from the perspective of the generalized virtual economy from the perspectives of enterprise technology innovation, service innovation and management innovation. In order to solve the inherent defects in the practical application of traditional QFD, such as the evaluation of the relationship between customer psychological needs and engineering technology, the determination of the weight of customer psychological needs and the prioritization of engineering technology, a QFD method considering customer psychological behavior in a probabilistic language environment is proposed. The initial weight of customers' psychological need is determined by PL-MAHP. According to the relationship between customer psychological need, fuzzy cognitive map (FCM) is used to infer and analyze customer psychological need and obtain its final weight. PLTS is used to characterize the correlation strength between customer psychological need and engineering technology. The influence of customer psychological behavior on the priority of engineering technology is fully considered.

The main product of the automotive air conditioning company A in Zhejiang, China is the parallel flow condenser of automotive air conditioning, air conditioning parallel flow condenser, serpentine condenser, cascading evaporator, water tanks, receiver drier, expansion valve. There are more than 1,000 specifications that are available for customers. The company has the technical research department, which includes higher level technicians specializing in new product development. The company adopts the international advanced computer design systems[6]. The staffs of the research and development of this company have the strong ability to design and develop the products. The products are updated quickly. The company has gotten ISO 9001 and TS 16949 quality management system certification, and the product performance of the company is stable and reliable. But in recent years, the company has received many complaints from the customers about parallel flow condenser. The complaints are mainly concentrated in the following areas.

(1) Nitrogen leaks from conductor products and they are considered to be broken. The time of pressure testing is too short to make sure whether there is nitrogen leakage in the subsequent product.

(2) The cooling of the condenser is not optimal. The designer isn’t optimizing the products. The raw materials purchased do not meet the design requirements. Production of tool design for mold is not reasonable, and accuracy of the design is not high. The reason for the disadvantage mainly caused that the hot runner mold of the spare parts’ cooling plate is too narrow. The fin cutting tool occurs the window angle errors. The reason is due to the layout of the space between the windows is not reasonable[7].

(3) The appearance of the condenser is in poor-quality and is not cleaned. In the process of the production, the condenser is pasted some machine oil. For the reason, the condenser will get dirty, partly.

(4) The size of condensers’ interface varies widely. It is hard for the workers to make a butt joint. The

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workers cannot install a frame of the car by reference to the drawing. With the plate welding fixture, the position of the rack cannot be shifted.

(5) During the transportation, the products will be out of shape because of improper packing. Carton designs are not ideal. Products in a box are not fixed in the transportation, the situation has often happened easily[8], and the products are smashed because of the products up and down. In order to solve the above problems, to improve customer satisfaction and loyalty, and to reduce customer complaints, the company has set up the team for the condenser research. A part of the authors have worked for the company as their outside experts, and have been directly involved in the implementation process of the whole project. The following sections explain the entire project process used a specific application of quality tools.

2.2 The KANO Model and the Application Process of QFD

2.2.1 The Production Process of Parallel Flow Condenser

The production philosophy of the company stated in this paper is "high quality, high efficiency, low carbon, and safety." In order to meet the requirements of the customers and to improve the concentration of the company's workers, the company has used the production modes of tracking task lists process. The company analyzed the production process systematically and has achieved dynamic management. The company manages the internal allocation of resources, based on the company's annual sales forecast. Planned orders are transferred to relevant departments to implement the production order by the software system named "Guanjiap." [9]. The process includes order processing, material planning, order purchase, supplier preparation, inspection, assembly, warehousing, material, process and product testing.

2.2.2 Customer satisfaction surveys based on the Kano model

The Japanese professor Noriaki Kano proposed a so-called Kano model in 1984 [10]. He proposed the classification of quality elements composed the product quality. The quality elements are classified into 5 categories that are the attractive quality element, one-dimensional quality element, must-be quality element, indifferent quality element, and reverse quality element. In this paper, we use only the attractive quality element, one-dimensional quality element, and must-be quality element, since these three elements are often used elements. Figure 1 shows the relation of their quality elements. Among them, the must-be quality element is a quality element corresponding to the basic requirements (or basic needs) for enterprises to provide the products or services. This is the indispensable quality element or features considered by consumers about the product or service. When the quality element is not sufficient (does not meet customer needs), the customers are not satisfied. Even if their identity of the product or service is sufficiently charged (does meet customer satisfaction), the customer may not exhibit satisfactory. In other words, if this element is satisfied, the customer feels naturally, but if it is not satisfied, the customer complains. If there is a bit of negligence of the product or service, the product or service does not come up to the customer's expectations. Then, the customer satisfaction will plummet. For the customers, these requirements must be met. By applying the idea of the Kano model, the customer satisfaction surveys of the company can assist business parties to make the decision about the subsequent work. The quality elements of the Kano model is shown in figure 1.

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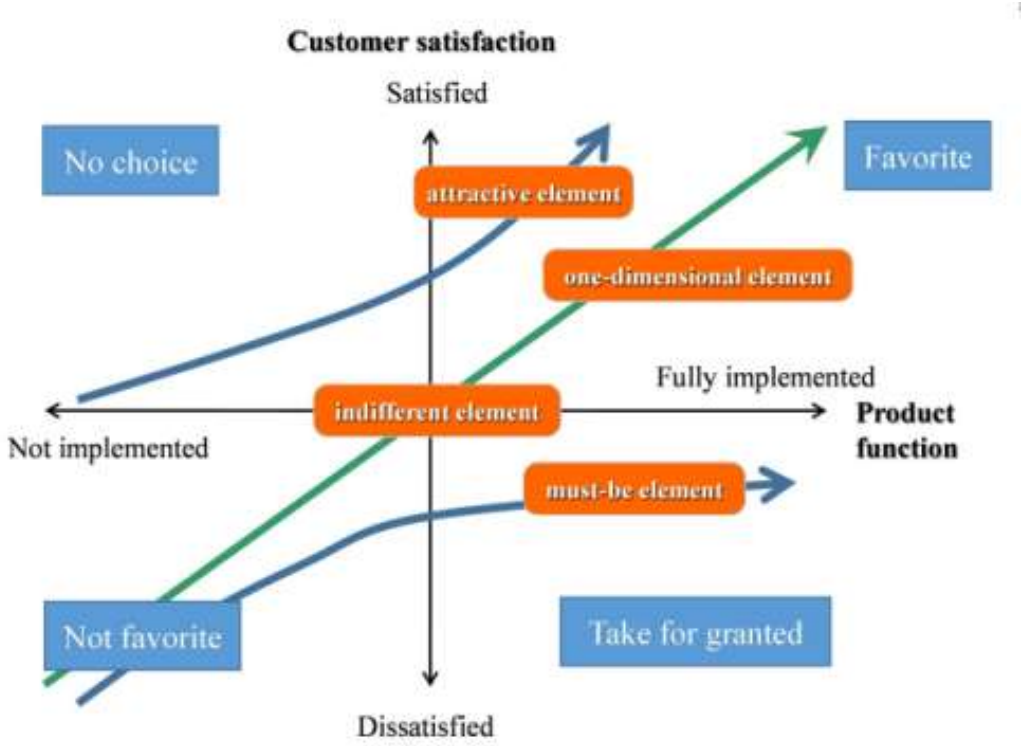

Figure 1: Quality elements of the Kano model.

In practical work, the company should take possible actions to meet the basic needs of the customers. The company should guarantee the all questions raised by the customers are resolved seriously. The company should pay attention to finish the work that the customers believe important and should provide convenience for customers as possible as they can. The company should achieve customer's satisfaction with the basic requirements. Namely, the must-be quality elements should be satisfied. The company should try to meet the expectations or exciting of its customer's needs. This is the quality of competitive factors. By providing additional services or products of customer favorite features, the company makes different products or services better than that of the competitors, guides customers to strengthen good impressions of this company[11], and enables customers to ensure their satisfaction. Finally, by taking this action, the company can meet the customer's excitement needs and establish the most loyal customer base.

2.2.3 The traditional QFD matrix for the quality of planning

Now, the authors will focus on planning and prevention not only in problem-solving. In the traditional QFD, the company usually uses customer recognition data for a competitive analysis. For the competitive analysis, the company should set the target of customer satisfaction value based on every customer demand characteristics. After that, the company calculates improvement rate. The company adjusts the initial value of importance from improvement rate. Finally, the company decides the value of importance. But the value of importance may not be accurate and may not be able to give what the customers really want.

Figure 2 shows an example about a part of the quality of planning table in QFD about parallel flow condenser for car air conditioning. The raw importance's value had been identified by using a 1-5 scale. In

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the quality of planning table in traditional QFD, there is the field for the value of selling points, but the authors decided not to use the field. The reason is that it can be evaluated without using the values of selling points, and the omitting of this field is not much trouble. The authors also conducted a customer satisfaction (CS) survey and summarized it in the table.

Customers are asked to rate their customer satisfaction degree for the company and two competitors using a 1-5 scale for each customer quality requirement. The value of the importance of required quality is computed as their average of evaluation values. The value of customer satisfaction (raw CS) is calculated in the same way. As an example, we consider the "strong packing," which is the requirement of the 3rd level of customer quality requirements in the first item of Figure 2. Since the target value of the customer satisfaction is set to 4 and this company's quality revel is 3, the ratio of level-up (the improvement ratio) becomes ⍁⍁ = 1.33. In other words, in order to meet this customer quality requirement, it is necessary to raise the level of this company about this request to 1.33 times[13]. On the other hand, this requirement is corresponding to the must-be quality of the Kano model. This indicates that customer satisfaction may not be achieved even if increasing the quality level of the company to 1.33 times, because it is the must-be quality element of the Kano model. Unless the quality of this company is raised to a level exceeding 1.33 times, it will not be possible to reach the must-be quality element level. As a result, the desired level of customer satisfaction may not be possible to be achieved. The data of it is shown in figure 2.

Customer quality requirements			Competitive analysis					Quality of planning	Ratio of level-up	Adjusted imp. of required quality	Adjusted weight of required quality
1st level	2nd level	3rd level	Imp. of required quality	Raw CS	Own company	Company X	Company Y				
Parallel flow condenser product	Elegant and sturdy package	Strong packing	4.50	3.90	3	2	3	4	1.33	5.985	0.078
		Good product cleanliness	4.40	3.80	3	3	4	4	1.33	5.852	0.076
	Timely delivery	Sending samples in a timely manner	4.10	4.15	4	3	4	4	1.00	4.100	0.053
		On-time delivery	4.20	4.25	4	3	3	4	1.00	4.200	0.055
	Equitable price	High-performance cost ratio	4.15	4.20	4	3	3	4	1.00	4.150	0.054
		Supplying a certain discount	3.90	3.95	4	3	3	4	1.00	3.900	0.051
	Dependable quality	Variety of quality components and reliable	4.20	3.80	3	4	4	4	1.33	5.586	0.073
		Uneasy deformation	4.25	4.05	2	3	4	4	2.00	8.500	0.111
		Solid welding	4.30	4.05	3	3	3	4	1.33	5.719	0.074
		Non-leak products	4.40	4.15	3	3	3	4	1.33	5.852	0.076
		Good airproof function	4.20	3.90	3	4	3	4	1.33	5.586	0.073
		Product stability	4.25	4.05	3	4	3	4	1.33	5.653	0.074
		A long period of durability	4.30	4.10	4	4	4	4	1.00	4.300	0.056
	Good after-sales service	Rapid complaint handling	3.80	4.10	4	3	4	4	1.00	3.800	0.049
		The complaints process specification	3.60	4.00	4	4	3	4	1.00	3.600	0.047

Figure 2: Example of the quality of planning table of QFD.

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2.2.4 Integrated quality of planning based on the Kano model

In this case, the matrix of QFD integrated with the Kano model is able to be used in the quality planning stage by adjusting the ratio of level-up. It can correctly grasp the voice of the customer and has a better understanding of it. According to the transformation formula, the authors calculate the adjusted values, where is the adjusted ratio of level-up is the initial ratio of level-up about the importance of required quality, and is the parameter to express the different Kano's quality element types. If the characteristics of customers' demand are divided into some kinds according to the Kano's quality element types, then the value of k can be determined accordingly[14]. For example, the numerical values of k for the one-dimensional quality element (expectation type), the must-be quality element (basic type) and the attractive quality element (excitement type) are determined 1 and 2 respectively. In addition, the initial importance of each customer's demand characteristics is adjusted by the rate after improvement. The modified table is shown in Figure 3. The approach of [15] determines the Kano's quality element types by asking the customer, but our approach is set by the company itself while referring to the value of customer satisfaction and the characteristics of quality. The customers themselves often do not know the confident needs regarding quality. Therefore, it is reasonable for companies to decide. The data of the example of the revised quality of planning is shown in figure 3.

Customer quality requirements			Competitive analysis					Quality of planning	Ratio of level-up	Adjusted imp. of required quality	Adjusted weight of required quality
1st level	2nd level	3rd level	Imp. of required quality	Raw CS	Own company		Company X	Company Y				
Parallel flow condenser product	Elegant and sturdy package	Strong packing	4.50	3.90	3	M	2	3	4	1.33	7.965	0.081
		Good product cleanliness	4.40	3.80	3	M	3	4	4	1.33	7.788	0.079
	Timely delivery	Sending samples in a timely manner	4.10	4.15	4	O	3	4	4	1.00	4.100	0.041
		On-time delivery	4.20	4.25	4	O	3	3	4	1.00	4.200	0.042
	Equitable price	High-performance cost ratio	4.15	4.20	4	A	3	3	4	1.00	4.150	0.042
		Supplying a certain discount	3.90	3.95	4	O	3	3	4	1.00	3.900	0.039
	Dependable quality	Variety of quality components and reliable	4.20	3.80	3	M	4	4	4	1.33	7.434	0.075
		Uneasy deformation	4.25	4.05	2	M	3	4	4	2.00	17.000	0.172
		Solid welding	4.30	4.05	3	M	3	3	4	1.33	7.611	0.077
		Non-leak products	4.40	4.15	3	M	3	3	4	1.33	7.788	0.079
		Good airproof function	4.20	3.90	3	M	4	3	4	1.33	7.434	0.075
		Product stability	4.25	4.05	3	M	4	3	4	1.33	7.522	0.076
		A long period of durability	4.30	4.10	4	M	4	4	4	1.00	4.300	0.044
	Good after-sales service	Rapid complaint handling	3.80	4.10	4	O	3	4	4	1.00	3.800	0.038
		The complaints process specification	3.60	4.00	4	O	4	3	4	1.00	3.600	0.036

The symbols M, O, A in the field "own company" show must-be, one-dimensional, and attractive quality elements respectively.

Figure 3: An example of the revised quality of planning table.

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The symbols M, O, A in the field "own company" show must-be, one-dimensional, and attractive quality elements respectively. Also, the correspondence between customer quality requirement and quality element based on the Kano model can be implemented systematically. First, the company sets the level value of the quality of planning for each customer quality Parallel flow condenser product [16]. Requirement to be equal to or higher than the level values of the other companies. Next, the company decides which quality element category of the Kano model each customer quality requirement belongs to. From the result of the competitive analysis, when the company's current value of each customer quality requirement is less than the maximum value of the other companies, the requirement is a candidate belonging to the must-be quality elements. For other customer quality requirements, the requirement is a candidate belonging to the one-dimensional quality elements. The company selects customer quality requirements whose initial importance values are relatively low from the candidates of the must-be quality elements and make it a candidate belonging to the one-dimensional quality elements. Finally, with regard to customer quality requirements with high initial importance and high customer satisfaction value among candidates of the one-dimensional quality elements, the company decides candidates for attractive quality elements while considering the company's technical capabilities, production costs, and so on. The candidate decided in this manner is confirmed again and it is determined as the quality element of the Kano model.

As an example, the authors consider the "strong packing," which is the requirement of the 3rd level of customer quality requirements in the first item of Figure 3. The table shows that the customer pays attention to the requirements such as "strong packing, good product cleanliness, sending samples in a timely manner, on-time delivery, high-performance cost ratio, supplying a certain discount, variety of quality components and reliable, uneasy deformation, solid welding, non—leak products, good air proof function, product stability, long period of durability, rapid complaint handling, and the complaints process specification." However, customer satisfaction with these requirements is not so high. This indicates that there is room for development or improvement. In this quality of planning table of QFD integrated with the Kano model, the way of adjustment of the initial importance of required quality is different from the traditional method. For example, the adjusted weight of the required quality for "uneasy deformation" requirement of the 3rd level of customer quality requirements in the 8th item of Figure 2 is 0.111. On the other hand, the adjusted weight of the required quality for "uneasy deformation" requirement in Figure 3 is 0.172. As described in the previous analysis, the company must improve the quality against a large proportion of the products in order to get the desired customer satisfaction increase for must-be quality elements. Similarly, the increase of non-excited customer requirement ratio can obtain the increase of customer satisfaction. Expected requirement (one-dimensional quality requirement) is similar to this situation. Therefore, it is very important to meet the basic needs (must-be quality elements) of customers for the company, and the company resolves the questions raised by the customers, pays attention to customers' believe, has an obligation to take actions, and provides convenience for customers as much as possible. The company should achieve customer satisfaction of basic requirements (must-be quality elements). Then, the company should try to meet the expectations of its customers' needs. This is the quality of competitive factors. The company provides additional services or products of customer favorite features, and supplies different products or services better than that of the competitors. The company

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strengthens customers' positive impact on the products or services and enables customers to ensure their satisfaction. Finally grasping for customer excitement demand (requirements belonging to attractive quality elements), the company should establish the most loyal customer base. These methods have several further discussions such as follows.

First, the authors analyzed the Kano model based questionnaire results. Customer demand characteristics were divided into three types, namely basic (must-be quality), expectation (one-dimensional quality) and excitement (attractive quality). In addition to these three types, there were able to have some other findings, such as the irrelevant type, the contrary type, and the doubt type. But the company adjusts the importance of required quality through only three basic kinds of the Kano model that are more general[17]. Therefore the transformation formula cannot be applied to such quality elements if the company has taken such elements into consideration. Also, the company must pay attention to the customer needs. Whether the company satisfies the customer desires is influential to meet customer satisfaction. For other categories of the results, it should revise its questionnaire and analysis methods.

Second, the problem is how to determine the value of k. The value of k is a part of the simple formula which describes the Kano model in approximate quantitative meaning. In this formula, the value of k is an important parameter that reflects different kinds of the Kano model. In this method, a key issue is how to determine the appropriate values of k. In this paper, the authors used the same value used in the paper. However, there may exist more appropriate value than the value of k used in the paper [18]. In principle, the determination of the value of k depends on the relationship between QFD practice team's experience and understanding. Also, it may exist more appropriate another formula.

Furthermore, in order to be able to understand the information provided by the Kano model better, the quality element types of the Kano model may be further subdivided into a number of types. For example, the characteristics of the excitement type can be further classified to a little excitement, moderately excited, very excited, and so on. The use of sub-types can distinguish between customer needs, thereby providing more useful information.

2.3 Application Effect Analysis

By the above analysis, this project team learned that customers concern mainly about strong packing, good product cleanliness, the variety of quality components and reliable, uneasy deformation, solid welding, non-leak products, good air proof function, and product stability. These requirements are with a high value of the adjusted weight of required[19].

Through the questionnaires, the authors found out what the customers were not satisfied with. Then, the company adopted appropriate policies to focus on improvement. After the improvement activation, the quality in the areas of the product and service had been greatly improved by importing a new management approach the authors proposed. Based on the new method proposed in this paper, the company adopted a new design by integrating the parallel flow condenser and oil cooler and by simplifying product structure,

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and it improved the efficiency of heat exchange. By designing and implementing products that are customer satisfied based on the new quality of planning, integrating QFD and the Kano model, this company gained the following major technical advantages.

Heat energy $\geqslant$ 11,500W (increased by 15%), whereas the original value of heat energy $\geqslant$ 10,000W Air-side resistance $\leqslant$ 95Pa (reduced by 13.6%), whereas the original value of air-side resistance $\leqslant$ 110Pa Flow friction $\leqslant$ 0.065MPa (reduced by 18.57%), whereas the original value of flow friction $\leqslant$ 0.08MPa According to the survey such as customer satisfaction investigation of the companies in China, the customer satisfaction of this company is located in the leading position in the industry. According to the results of the customer satisfaction survey, customer satisfaction is improving year by year and has been maintained a good development status. The quality level of the product is greatly improved. On-time delivery rate and other indicators are improving by importing the QFD and the idea of the Kano model as a quality management tool.

III. CONCLUSION

Each enterprise should be guided by the psychological needs of customers, and should highlight the product characteristics as much as possible in product innovation. Because of the limited survey samples, the concealment of products, and the complexity of product technological innovation, it is difficult to accurately and scientifically collect information to reflect the dynamic needs of customers. The main reason is that we still lack a unique thinking in the acquisition and analysis of customers' psychological needs to drive another kind of imperceptible or uncontrollable subconscious thinking from customers.

Based on the QFD design method integrated with the idea of the Kano model for car air conditioning, this paper provided a new method to analyze customer requirements. In the traditional QFD matrix in the quality of planning, the authors introduced the idea of the Kano model into the matrix. This paper divides customer needs into basic requirements (must be quality elements), expectation requirements (one-dimensional quality elements) and excited requirements (attractive quality elements), and adjusts the degree of importance of customer required quality. Through the questionnaire, this project got the information about the things which customers are not satisfied with. Then, the company was able to adopt an appropriate policy to focus on improvement. As a result, the products and services of this company have been greatly improved.

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REFERENCES

[1] ISO 16355-1:2015 (2015), Application of statistical and related methods to new technology and product development process -- Part 1: General principles and perspectives of Quality Function Deployment (QFD), ISO 16355-1:2015, 2015.

[2] Noriaki Kano, Nobuhiko Seraku, Fumio Takahashi, and Shinichi Tsuji (1984), Attractive quality and must-be quality. Journal of the Japanese Society for Quality Control (in Japanese), Vol. 14, No. 2, pp. 39-48, 1984.

[3] Kurt Matzler and Hans H. Hinterhuber (1998), How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment, Technovation Vol. 18, No. 1, pp. 25-38, 1998.

[4] Kay Chuan Tan, Min Xie, and Xiao-Xiang Shen (1999), Development of innovative products using Kano's model and quality function deployment, International Journal of Innovation Management, Vol. 3, Issue 3, pp. 271-286, 1999.

[5] K. C. Tan and X. X. Shen (2000), Integrating Kano's model in the planning matrix of quality function deployment, Total Quality Management, Vol. 11, Issue 8, pp.1141-1151, 2000.

[6] Anthony Halog, Frank Schultmann, and Otto Rentz (2001), Using quality function deployment for technique selection for optimum environmental performance improvement, Journal of Cleaner Production, Vol. 9, Issue 5, pp. 387-394, 2001.

[7] Fariborz Y. Partovi and Rafael A. Corrodoira (2002), Quality function deployment for the good of soccer, European Journal of Operational Research, Vol. 137, Issue 3, pp. 642-656, 2002.

[8] Madeleine E. Pullman, William L. Moore, and Don G. Wardell (2002), A comparison of quality function deployment and conjoint analysis in new product design, Journal of Product Innovation Management, Vol. 19, Issue 5, pp. 354-364, 2002. The 24th International Symposium on Quality Function Deployment ISQFD'18 – Hong Kong

[9] Liang-Hsuan Chen and Ming-Chu Weng (2003), A fuzzy model for exploiting quality function deployment, Mathematical and computer modelling, Vol. 38, Issues 5–6, pp. 559-570, 2003.

[10] San Myint (2003), A framework of an intelligent quality function deployment (IQFD) for discrete assembly environment, Computers & Industrial Engineering, Vol. 45, Issue 2, pp. 269-283, 2003.

[11] E. Ertugrnl Karsak (2004), Fuzzy multiple objective programming framework to prioritize design requirements in quality function deployment, Computers & Industrial Engineering, Vol. 42, Issue 18, pp. 149-163, 2004.

[12] Lai-Kow Chan and Ming-Lu Wu (2005), A systematic approach to quality function deployment with a full illustrative example, Omega, Vol. 33, Issue 2, pp. 119-139, 2005.

[13] Irem Dikmen, M. Talat Birgonul, and Semiha Kiziltas (2005), Strategic use of quality function deployment (QFD) in the construction industry, Building and Environment, Vol. 40, Issue 2, pp. 245-255, 2005.

[14] Yizeng Chen, Richard Y. K. Fung, and Jiafu Tang (2006), Rating technical attributes in fuzzy QFD by integrating fuzzy weighted average method and fuzzy expected value operator, European Journal of Operational Research, Vol. 174, Issue 3, pp. 1553-1566, 2006.

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[15] Richard Y. K. Fung, Yizeng Chen, and Jiafu Tang (2006), Estimating the functional relationships for quality function deployment under uncertainties, Fuzzy Sets and Systems, Vol. 157, Issue 1, pp. 98-120, 2006.

[16] Chih-Hung Hsu, Tsan-Ming Chan, Shih-Yuan Wang, Pei-Yi Lin (2007), Integrating Kano's model into quality function deployment to facilitate decision analysis for service quality, Proceedings of the 8th WSEAS International Conference on Mathematics and Computers in Business and Economics, pp.226-232, 2007.

[17] Felix T. S. Chan, N. Kumar, M. K. Tiwari, H. C. W. Lau, and K. L. Choy (2008), Global supplier selection: a fuzzyAHP approach, International Journal of Production Research, Vol. 46, Issue 14, pp. 3825-3857, 2008.

[18] Chun-Chang Lin, Wei-Chih Wang, and Wen-Der Yu (2008), Improving AHP for construction with an adaptive AHP approach (A3), Automation in Construction, Vol. 17, Issue 2, pp. 180-187, 2008.

[19] Amir Sanayei, S. Farid Mousavi, and A. Yazdankhah (2010), Group decision making process for supplier selection with VIKOR under fuzzy environment, Expert Systems with Applications, Vol. 37, Issue 1, pp. 24-30, 2010.