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Improved Kansei Engineering with Quality Function Deployment Integration: A Comparative Case Study

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Abstract. Consumer needs for a product has shifted from not only from the functional or usability side but began to emphasize the emotional needs (Kansei). It is proposed that Kansei engineering (KE) and quality function deployment (QFD) methodology be simultaneously used to convert customers' voice both for functional and emotional requirementsin product design. A new integration QFD-KE model was developed to meet the changes in customer requirement. The strength of the new model is compared to the QFD-KE model developed by previous researchers. Medical glove was used as case study for the comparison. It can be concluded that the new QFD-Kansei integration method is more accurate in determining the technical targets of the technical characteristics used both in terms of quantity and quality

1. Introduction

Companies must intensively strive to increase customer satisfaction and loyalty to win the competition [1],. Traditional customer satisfaction alone is not enough in today's competitive business environment. The trend of consumer desire in the 21st century is leaning towards hedonism, pleasure and individuality. This desire stimulates customers to shift their focus on ergonomic hedonism compared to product functionality [2]. Consumer needs for a product is not only from the functional or usability side but began to emphasize the emotional needs (Kansei).Consumers' selection of a product now seems irrational. Price, quality assurance and function are no longer the main criteria for choice, but those which are attractive and inviting to the five senses has become the chosen one. Pampering the customer now become an important issue for long term business success [3].

In the QFD method, needs data are collected using interviews, activity analysis etc. the data were then evaluated and interpreted using 'Voice of Customer' Table. Voice of Customer (VoC) expressed by the customers usually come in qualitative form, hence contains ambiguities in meanings. This cause difficulty when analysing the relationship between customer demands with engineering characteristics [4].

Kansei Engineering (KE) has a strong ability to accommodate these trends while meeting the emotional needs of customers / Kansei [5,6]. Kansei Engineering (KE) is designed to evaluate human desires and needs and provide mathematical and statistical values to connect technical needs to responses [7]. KE is considered superior in translating the customer's emotional needs into product attribute parameters through engineering compared to other similar methods [8].

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2. Literature Review

The shifting of customers requirement from pure functional and financial perspective to the involvement of hedonistic needs require a new set of thinking in product design. It is proposed that Kansei engineering (KE) and quality function deployment (QFD) methodology be simultaneously used to convert customers' voice both for functional and emotional requirements.

QFD which is based on subjective expert knowledge, offers several different tools. Kansei Engineering on the other hand, offers an opportunity to collect customer attitudes about the importance of different properties of different products. the KE method also has the potential to modify and optimize product properties that are not directly visible. Thus, KE can be integrated with QFD [8]. Llinares and Page [9] assert that KE is a suitable framework for connecting user or consumer perceptions of product or service attributes in the form of words. Table 1.0 summarizes the only two findings from studiesregarding the use of Kansei Engineering method in defining the attributes of consumers' emotional desires in product design.

Table 1. Determining and Selecting Product Design Attributes using Kansei Engineering

Year	Author (s)	Parameter/ Variable	Field used
2009	Narges Alanchari and Nata Tolooe	Kansei word, Customer Requirements, Technical Specifications / Characteristics	LCD Monitor Design
2012	Wassanai Wattanutchariya and Tanitta Royintarat	Kansei word, Customer Requirements, Technical Specification / Technical Characteristics	Design and Development of rice Products

The lack of literature showed that little research work had been done in this area. Furthermore, the previous combination of KE-QFD were only done in the first phase of QFD's house of quality. A new KE-QFD integration method was developed and to be compared to the previous KE-QFD integration method. The New combination of KE-QFD was done for both QFD first and second phase. For fair comparison, only first phase was used.

3. Methods

A case study was used to explain the application of the integrated design model. Product samples of medical gloves are collected and then were sorted by attribute category. The Kansei words were collected through articles pertaining to gloves via magazines, catalogues, and internet. The negative and positive of the selected of Kansei words are determined. The words were then arranged using the 5-point semantic differential scores assessment scale.In the new integration method, Kansei Engineering processing begins by testing the validity and reliability of the distributed semantic differential questionnaire.

Validity test is done based on semantic differential questionnaire data which contained ten product design using Pearson's product moment correlation equation. Based on the case study, coefficient of product moment correlation was above 0.36 which signified there was internal consistency in the variable. Cronbach Alpha formula was performed to test reliability of semantic differential data is carried out to determine thequestionnaire's reliability. The value of performance reliability coefficient was obtained at 0.4888. The critical value of Pearson r correlation coefficient at 5% significant level, with respondents of thirty was 0.36. Therefore, the questionnaires are reliable.

The attribute categories of selected glove items, both for new and old methods, are: material, colour, surface content, disposability, thickness, inside content and the scent of the gloves. The category of the design is selected based on most number of the Kansei word with the greatest utility value.

The gloves category was evaluated by respondents based on Kansei word assessment. Conjoint statistical analysis method was used in the evaluation. The results of the showed that the preferred glove should:

- made of nitrile material
- pink
- have protein allergen
- disposable
- thin
- have flour or talcum powder inside it and
- peppermint scented

4. Result and Discussion

4.1. Determining Weightage of Customer Needs.

The importance level of consumer needs variable was assessed using Likert-scale weightage. Closed needs priority questionnaire distributed to thirty respondents was used to obtain the mode values . The questionnaire was. The mode valuesare obtained based on the frequency of respondents' answers and it becomes the level of importance. Table 2 showedthe comparison of customers'priorities on variables in the attribute category based on the new KE-QFD integration method and previous KE-QFD integration method. The table showed very similar priorities ranking results in both methods

Table 2. Customer Importance (CI)

No.	Attribute	New Method	Previous Method
1	made of nitrile material	4	4
2	Pink	5	5
3	have protein allergen	4	4
4	disposable	5	5
5	Thin	2	2
6	have flour or talcum powder inside	4	4
7	peppermint scented	5	5

5 = Very Important

4 = Important

3 = Moderately Important

2 = Slightly Important

1 = Not Important

Previous QFD-KE integration model do not have validity testing. Table 3 showed the result of validity test for new model using the Pearson product moment correlation equation. The value of All attributes correlation coefficient is above 0.361. It indicates that the question on the questionnaire Kansei model is valid

Table 3. Validity Calculation of Kansei Model

Attribute number	Correlation Coef.	r Table	N	Description
1	0,508	0.361	30	Valid
2	0,578	0.361	30	Valid
3	0,655	0.361	30	Valid
4	0,631	0.361	30	Valid
5	0,645	0.361	30	Valid
6	0,442	0.361	30	Valid
7	0,513	0.361	30	Valid

Performance reliability coefficient was calculated to be 0.648 using Alpha Cronbach formula. As the value of calculated r > r table, therefore the result was reliable.

4.2. Technical Requirements Identification.

Sections should be numbered with a dot following the number and then separated by a single space: Brainstorming technique was used in new integration method together with interviews and discussions techniques in determining product technical characteristics. The previous integration methods, applies only interviews and discussions techniqueswith production managers as means to determine technical characteristics. Technical characteristics of glove products can be seen in Table 4. below.

Table 4. Technical Characteristic of Glove Products

No	New Method Technical Characteristic	Old Method Technical Characteristic
1	Accuracy of Materials Mixing Process	Accuracy of Materials Mixing Process
2	Thoroughness of Removal from Mould	Thoroughness of Removal from Mould
3	Temperature on Coagulant Oven	Temperature on Coagulant Oven
4	Overall Dipping Process	Temperature on dipping process
5	Accuracy of Leaching Process	Accuracy of Printed Washing
6	Print Variance	
7	Dimensional Conformity	
8	Liming process (Slurry)	
9	Cleanliness and Accuracy of Mould Washing	
10	Standard Specification of Gloves Product	
11	Quality of Raw Materials and Chemicals	

Table 4 indicated that many more technical characteristics of glove products can be obtained by using the new integration model.

4.3. Critical Part Identification Analysis

Critical part analysis is to identify the most important characteristic ofpart or component on glove product. Similarly, the new integration methods applied brainstorming technique together with

interviews to identify critical part and its characteristics while the old integration method only used interviews with production managers. The critical part of glove products can be seen in Table 5. below.

Table 5. Critical Part on Glove Product

No	New Method	Old Method
1	Glove layer thickness	Glove layer thickness
2	Dimensions of gloves	Dimensions of gloves
3	Accuracy of gloves release	Accurate release of gloves
4	Colour suitability	colour suitability
5	The amount of powder	The amount of powder
6	protein allergen amount	protein allergen amount
7	Mixing Material Composition	Mixing Material Composition
8	Rubber Sheet thickness	Rubber Sheet thickness
9	Material Elasticity	
10	Material Resistance Temperature	
11	Crack endurance (Tensile)	
12	Consistency of Chemical PH	
13	AQL (Acceptable Quality Level) ≤ 1.5	
14	Vulcanization quality	

The table 5 also indicated that the new KE-QFD integration is capable to identify more numbers of critical parts and its characteristic than the previous one

4.4. Discussion

Based on the analysis of QFD's first phase of house of quality, it can be concluded that the new QFD-Kansei integration method is more accurate in determining the technical targets of the technical characteristics used both in quality and in quantity.This is due to the attainment of more technical characteristics and the use of different scales in comparison to the old method. The new QFD-KE integration method used group-oriented brainstorming techniques. Top and Middle Management were also involved in determining the attributes of technical requirements and critical part attributes, which resulted in obtaining the attributes in a more objective manner

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