An Integration of Kano Model and Quality Function Deployment Technique – A Case Study Using Sport Earphone

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Abstract. Product modification is predetermined as another important approach to capture market demand and competitor situation. Development and marketing strategy of product with modified features by designer as an attractive element for consumers. Therefore, this paper discusses an approach and process that would help the product development team to develop an innovative products with attractive qualities. Customer requirement and satisfaction evaluation can be accomplished via various methods. In this study, the integration between Kano Model and Quality Function Deployment was identified to evaluate the customer satisfaction based on the proposed product. A survey was conducted among 80 athletes to determine the possibility criterion for improvement on an existing sport earphone, in term of various aspect such as design, material used, appearance and accessories. After that, the result was interpreted into a Kano questionnaire and answered by 80 respondents. Consequently, it was analyzed and applied in the House of Quality matrix. At the end of this study, it was found that both methods were able to prioritize the modification of essential features to be executed into the sport earphone which can be profitable in developing a product in such a way that maximum customer satisfaction can be achieved. Therefore, an integration of Kano Model and Quality Function Deployment, can be a great assistance when it comes to understanding the needs of users, satisfaction of users who use the sport earphone at long period, in order to give more comfort for consumers.

1. Introduction
The principal objective of the companies is to produce market products and services to meet demands and requirements of customers. According to Bilgili et al., (2011), reported that marketing begins with the survey of the requirement of consumers who are habitual end users of that product [1]. Based on previous literature, accurate comprehension of customer’s requirements is a necessary step in product development as it basically determines how strong the organization’s has capability to satisfy customer expectations, though Kano’s model have been adopted over the years to assimilate voice of customer in the product design. Nevertheless, the employment of Quality Function Deployment (QFD) is another alternate way that have been engaged to figure out customer attributes reported by Iqbal et al., (2015) [2]. Moreover Tu et al., (2011) states that traditional QFD method does not
prioritize the Customer requirements CRs [3]. Therefore in this study, applying Kano model in QFD can help represent and quantify the CRs, and relate those elements to the overall customer satisfaction goal in order to evaluate different design alternatives. There have been previous studies on several methods used for product development among which include; Tu et al., (2011) combined Analytical Hierarchy Process with Quality Function Deployment method in the development of new sport earphone. Senthil Kumar et al., (2012) also used Pairing of Intelligence Design Concept Method and Kano Model for Product Development, from the findings of the research, the need was identified and package design concept support method was used to analyse the comfort and aesthetics of a concept car [4]. Similarly, Chen & Chuang, (2008) integration of Kano model into a robust design approach to enhance customer satisfaction with product design. The study presented a robust design approach incorporating the Kano model to get the excellent combination of design form elements in which mobile phone design experiment was carried out to certify the benefits of using the proposed integrative approach. Results showed that the produced optimal mobile phone design can adequately enhance comprehensive aesthetic performance and customer satisfaction [5]. Kano model, withal called attractive quality theory, is proposed by Dr. Kano in 1984, which expounds how the relationship between the sufficiency of a given quality attribute and its resultant customer gratification can be distinguished in five perceived quality dimensions as shown in figure 1. Each question on the pair structures, each pair asks about the consumer’s feelings in the case of fulfillment of an attribute [a functional question] and the other question asks about feelings in the case of non-fulfillment of an attribute [dysfunctional question] (Mikulić & Prebežac, 2011) [6].

![Kano model of customer satisfaction (Turisová, 2015).](image)

Therefore, in this research will focus on gathering customer’s needs through interviews with Kano’s questionnaires, and the outcome of questionnaires will be selected and evaluated, before constructed the matrix of House of Quality (HOQ) in Quality Function Deployment. Finally, as an expected the results will identified the customers need on the development of sport earphone.

2. Methodology

In this research, the methodology steps based on the Product Development Process, which is Idea Generation at the first stages as shown in figure 2 and figure 3 shows the structures of research framework.
Figure 2. Product Development Process.

First step: Identify customer needs

Identify the needs of customers with the use of Kano’s model questionnaire and classify into three groups: Must-be, One dimensional and Attractive requirement

Second step: Examine ways to improve customer satisfaction

Voice of customers used in a qualitative approach to develop technical specifications to become functional requirement

Third step: Ranking customers needs

Prioritizing the needs identified will be based on expert opinion and expert questionnaire with AHP

Finish

Figure 3. Structures of research framework.
2.1 Kano Model Questionnaire

The Kano model assists in apprehending the input to the QFD process, i.e. the voice of the customer. Subsequently, the two techniques are integrated into the novel product development process in searching for modified features and attractive quality production (Kay Chuan Tan, Xie, & Shen, 1999) [7]. A sample of Kano Model questionnaire for this study is presented in table 1 and table 2, represents as a Kano Evaluation Table.

![Table 1. Kano Model questionnaire.](image)

![Table 2. Kano Model questionnaire.](image)

2.2 Customer Satisfaction Coefficient

Gupta & Srivastava, (2011) showed that, the fact that the CS coefficient indicates whether the customer delight can be improved or not, by achieving the product requirements. The normal effect on satisfaction or dissatisfaction can be calculated using the following equations respectively [8];

Extent of satisfaction:

\[
SI = \frac{(A + O)}{(A + O + M + I)}
\]  

(1)

Where:
- A is Attractive,
- O is One-Dimensional,
- M is must-be,
- I is Indifferent requirements.
R is Reverse
Q is Questionable
Extent of dissatisfaction:

\[ DI = (-1)(O + M)/(A + O + M + I) \]  

(2)

The minus sign is used in equation (2) to indicate the nullifying result on CS if the product quality is not achieved. On one hand, the positive CS coefficient with range starts from 0 until 1; e.g. as the value approaches 1, the customer becomes more satisfied. However, when approaching a value of 0, the customer becomes less satisfied with the achieved requirement. On the other hand, if the negative CS coefficient approaches -1, the customer dissatisfaction is strongly affected when the product requirement is not achieved. Finally, the 0 value indicates a neutral impact on the customer when the requirement is not achieved (Gupta & Srivastava, 2011).

2.3 Applying Quality Function Deployment (QFD)
The QFD technique proceeds with understanding and analysing the requirements of the customers. This is the most crucial and elongated step in the QFD design. The experts in this system need to identify and discuss the necessary requirements to meet ‘the wants’ from customer perception. After that, the information is analysed in a matrix system called as house of quality (HOQ) which “links customer needs to the development team’s technical responses to meet these needs”. The HOQ matrix is shown in figure 4.

![Figure 4. The frame work of QFD.](image)

3. Result and Discussion

In this study, Kano Model was used to find out what are the customer requirements need from their expectation for the sport earphone product. A questionnaire was developed and distributed to the 80
respondents among athletes. There have three stages on the computation process of the questionnaire, which is Kano Model questions (with combining of functional and dysfunctional form), evaluation on the table elements was engaged to classify the answers, based on table 2 and finally, classified the answers based on the element and priority for further investigation. There have 5 factors and 10 features as shown in figure 5.

| No. | Category | Features                      |
|-----|----------|-------------------------------|
| 1   | Design   | Hold position                 |
|     |          | Clear sound                   |
|     |          | Cool appearance               |
| 2   | Durability| Continuous usage              |
|     |          | Water proof                   |
| 3   | Ergonomics| Comfort                       |
|     |          | Control button                |
| 4   | Safety   | Open ear for safety           |
|     |          | Wireless                      |
| 5   | Cost     | Cheap                         |

Figure 5. Category and features for sport earphone.

Table 3 shows the result of Kano Model questionnaire from the 80 respondents. Data analysis was conducted by using Microsoft Excel software. All features were classified in 5 categories (Kano Model); Must – be (M), Attractive (A), One – dimensional (O), Indifferent (I) and Reverse (R). For the Indifferent (I) and Reverse (R), these 2 types of categories does not affect any customer satisfaction. From the table 3, it shows that among 10 features, 3 on the Attractive, 2 on Must-be and 2 on One-dimensional. According to Sauerwein et. al. [9], if the specific product requirements cannot be actually assigned to the various categories, the evaluation rule "M>O>A>I" plays a very important role [9]. The requirements have to be consummated if not, cause dissatisfaction. In order to decide which attractive requirements should be satisfied, the decisive factor should be how important that elements for the customer. Therefore, by using customer satisfaction equation, the result as shown in table 4. The indicator for the value in the Table 4, which is the satisfaction with the positive values included in the scope from 0 to 1. If the value is closer to 1, the impact of customer satisfaction is greater; positive coefficient, which approaches the value 0 indicates that there is very little impact, importance. However, it is important to see negative satisfaction values too. If the value is approaching towards -1, customer dissatisfaction is very strong; size, approximately equal to 0, meaning that a certain property does not feature such a high level of dissatisfaction. In this case, the minus sign is placed in a formula to emphasize its negative impact on customer satisfaction if this product quality is not fulfilled. Based on the result, it shows that water proof, wireless, comfort and cool appearance on the rank of high priority from customer need. However, for the clear sound and open ear for safety features, in Must-be categories.
Table 3. Result of Kano Model questionnaire with 80 respondents.

| Customer requirements | A  | O  | M  | I  | R  | Q  | Total | Category |
|-----------------------|----|----|----|----|----|----|-------|----------|
| Waterproof            | 27 | 25 | 10 | 15 | 2  | 1  | 80    | A        |
| Wireless              | 38 | 15 | 6  | 17 | 3  | 1  | 80    | A        |
| Continuous usage      | 19 | 35 | 9  | 14 | 2  | 1  | 80    | O        |
| Open ear for safety   | 13 | 23 | 29 | 12 | 2  | 1  | 80    | M        |
| Hold position         | 18 | 10 | 7  | 42 | 2  | 1  | 80    | I        |
| Comfort               | 15 | 30 | 14 | 19 | 1  | 1  | 80    | O        |
| Cool appearance       | 32 | 13 | 6  | 25 | 3  | 1  | 80    | A        |
| Cheap                 | 11 | 25 | 11 | 28 | 4  | 1  | 80    | I        |
| Clear sound           | 12 | 22 | 36 | 8  | 1  | 1  | 80    | M        |
| Control button        | 21 | 19 | 12 | 26 | 1  | 1  | 80    | I        |

Table 4. Customer Satisfaction (CS) and Dissatisfaction (CD) coefficient.

| Customer requirements | A  | O  | M  | I  | Total | Category | (A+O)/(A+O+M+I) | (O+M)/(A+O+M+I)*(-1) |
|-----------------------|----|----|----|----|-------|----------|------------------|----------------------|
| Waterproof            | 27 | 25 | 10 | 15 | 80    | A        | 0.70             | -0.50                |
| Wireless              | 38 | 15 | 6  | 17 | 80    | A        | 0.70             | -0.30                |
| Continuous usage      | 19 | 35 | 14 | 9  | 80    | O        | 0.40             | -0.60                |
| Open ear for safety   | 13 | 23 | 29 | 12 | 80    | M        | 0.50             | -0.70                |
| Hold position         | 18 | 10 | 7  | 42 | 80    | I        | 0.40             | -0.20                |
| Comfort               | 15 | 30 | 14 | 19 | 80    | O        | 0.60             | -0.60                |
| Cool appearance       | 32 | 13 | 6  | 25 | 80    | A        | 0.60             | -0.30                |
| Cheap                 | 11 | 25 | 11 | 28 | 80    | I        | 0.50             | -0.50                |
| Clear sound           | 12 | 22 | 36 | 8  | 80    | M        | 0.40             | -0.70                |
| Control button        | 21 | 19 | 12 | 26 | 80    | I        | 0.50             | -0.40                |

By using integration with House of Quality (HOQ) in Quality Function Deployment method, the objective from this study were achieved, as shown in figure 6. The significant characteristic on this case study, which is clear sound design, where it is the Must-be requirement for ensure the structures of material and design meets the requirement as a best sport earphone (Husin et.al, 2017) [10]. Based on Kano Model, it showed that the element on the Must-be categories and following with open ear for safety. After that, the important characteristics were wireless (A), water proof (A) and continuous usage (O).
4. Conclusion

In this study, the combination of Kano Model and QFD shows the successful approach, in order to identify the most significant or customer demand, based on the customer voice during product development process. The application of the Kano model is useful for improved comprehension of customer needs while its integration in QFD matrix will assist product designers to determine most important element need to consider, before finalised decision on product design. In this case study, it shows that the customer demand are safety qualities and will be satisfied if, it were fulfilled with safety design and clear sound earphone. However, the three (3) features from the result on the Attractive categories which means that the requirements will lead to a great satisfaction for the customers. As expected, from this study it shows the suitability on combination method, which is Kano Model and QFD, at the early stages of product development process (PDP) on idea generation condition before experimental or fabrication process, as reported by Arifin et al., (2014) [11, 12]. This procedure also can help and ensure, the customers really want for maximum satisfaction and success on market industrial.

**Figure 6.** House of Quality (HOQ) for sport earphone.
5. References

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6. Acknowledgement
The author would like to express their gratitude to Universiti Tun Hussein Onn Malaysia for supporting these research activities.