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ORIGINAL ARTICLE

Integration of Kano's Model into quality function deployment (QFD)

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Abstract Viability of a product or service in the market depends upon the satisfaction that it can extend to its customers through quality. Quality function deployment (QFD) is a tool that gathers voice of customer (VoC) and inducting the expected features in the final product. It is also desirable that the practitioners of QFD must extend due importance to latent expectations of the customers, which in turn may fulfill overall customer satisfaction for a product or service. Kano et al. (J Jpn Soc Qual Control, 14:39–48, 1984; 1996) and Kano (2001) have suggested a method to identify the different categories of requirements through customer responses. Based on the QFD and Kano model analysis, a function has been proposed to adjust the traditional improvement ratio (Tan and Shen, Total Qual Manag 11:1141–1151, 2000) for each product or service attribute to recognize the importance of a attribute, which can be helpful in developing a product or service in such a manner that maximum customer satisfaction can be achieved. The proposed methodology has been illustrated using customer survey data.

Keywords Kano's model · Quality function deployment (QFD) · Theory of attractive quality · Customer satisfaction

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1 Introduction

Customer satisfaction has been a matter of concern to most of the companies. Satisfaction ratings are being used as an indicator of the performance of services and products and help to formulate strategies of the companies. Hanan and Karp [5] have stated that "Customer satisfaction is the ultimate objective of every business: not to supply, not to sell, not to service, but to satisfy the needs that drive customers to do business." Market success of a product is also important from the environment point of view, since a product which is not sold, becomes the most useless product from both economical and environmental point of view. It has environmental impacts without having any value for the customer [3].

Due to shorter product life cycles, businesses are looking for the ways to reduce product development time and to introduce their products to the market more quickly and successfully and on the other hand customers demand for more customized products. For this, identifying customer needs and transforming it into product design is very important to remain competitive in market [18]. Hence, there is a need to study and develop procedures that can help a company or project team to gain knowledge of customer requirements and satisfaction, and then develop products with innovative features.

Quality function deployment (QFD) is an overall concept that provides a means of translating customer requirements for each stage of product development and production [15]. QFD was born as a method or concept for new product development under the umbrella of Total quality control [1]. QFD is a customer-oriented approach for product development based on an assessment of customer needs. It

helps a company to make trade-off between what the customer wants and what the company affords to build [12].

The fulfillment of customer needs depends on the existence and performance of certain product or service features. It can be seen that there are some requirements that bring more satisfaction to customer than others. By quoting an example of TV sets, Tontini [19] states that TV sets have achieved higher degree of reliability in market until this time so improving this reliability above the current level will bring less satisfaction than improving other requirements, like image quality, sound or connectivity etc. Therefore, it is important to determine those requirements of a product or service which bring more satisfaction than others. The Kano model [6] provides an effective approach to categorize customer requirements and to understand their nature. Kano's theory suggests a two-dimensional needs recognition method for quality in lieu of traditional one-dimensional method. This means that satisfaction of customer is not always proportional to state of physical fulfillment of requirements but some other relations also exist.

QFD and the Kano model can be integrated effectively to identify customer needs more specifically and to yield maximum customer satisfaction [12, 16, 18, 19]. By using the Kano model and integrating it in the QFD, the design team can understand the need of customers in a better way and can properly focus on it.

In the present work, a method of integrating the Kano model into QFD has been proposed. Further, a function has been proposed to adjust traditional improvement ratio for each attribute to recognize its importance for product or service design. A process model is given to apply the method successfully and unambiguously. The proposed methodology is illustrated by customer survey of daily internet users on development of "Good website design" attributes and comparison of results with other methods. A life cycle analysis is also made by comparing results of present approach with the method and Tan and Shen [16].

2 Quality function deployment

The original Japanese name for QFD was hin shitsu ki no ten kai. The translation is given below [10]:

*hin shitsu means quality or features/attributes;
*ki no means function or mechanization;
*ten kai means deployment, diffusion, or development/evolution

The Japanese view QFD as a philosophy which ensures high product or service quality in the design/development stage. The aim is to satisfy the customer by ensuring quality at each stage of the product development process.

QFD helps companies to identify customer requirements, and translates these requirements into design requirements, engineering specifications, and finally, production details. The product can then be manufactured to satisfy the customer's needs. QFD is an integrative process which links together customer needs, product design requirements, process planning, and manufacturing specifications during product development.

At the beginning of the QFD design process, the design team needs to listen to the Voice of the Customer (VoC). The VoC should represent the customer needs and is expressed in customer words. Usually, it is determined through personal interviews and/or focus groups. Based on the customer needs requirements are identified. After identification of requirements, a quantitative marketing research is conducted to evaluate the competitive position of the product in the market in terms of customer satisfaction and the importance given by customers to each requirement. Based on the competitive analysis, a target for customer satisfaction is set for each requirement. Then, an improvement ratio (target/current satisfaction) is calculated. This improvement ratio is then multiplied by the importance that the customer gives to each requirement and by the sales argument. The sales argument is sometimes used to amplify the weight of requirements that reinforce the company's sales strategy. The final relative weight of the requirements is then calculated [4, 19] (Fig. 1).

Thereafter, a set of design attributes that could fulfill the customer requirements is determined. Further, customer requirements and design attributes are correlated in a matrix called House of Quality, translating the voice of the customer into product specifications. The specifications for the design attributes are determined after doing a competitive analysis between the product being improved (or developed) and its competitors for similar products. After determining product's specifications and their relative importance, other matrices are developed for determination of process specifications, quality control specifications, and material requirements.

3 Problem definition

In the traditional importance adjustment technique, the relationship between customer satisfaction improvement ratio and importance increment ratio is treated as linear. It is assumed that increase in product or service performance will increase customer satisfaction in a constant proportion; however, this may not be true for every attribute [16]. It means that some of the attribute needs more attention than others. For customer attributes, customer satisfaction can be improved greatly with a little increase in importance value and vice versa. For example, customers may take 'sharp cutting edge' as granted

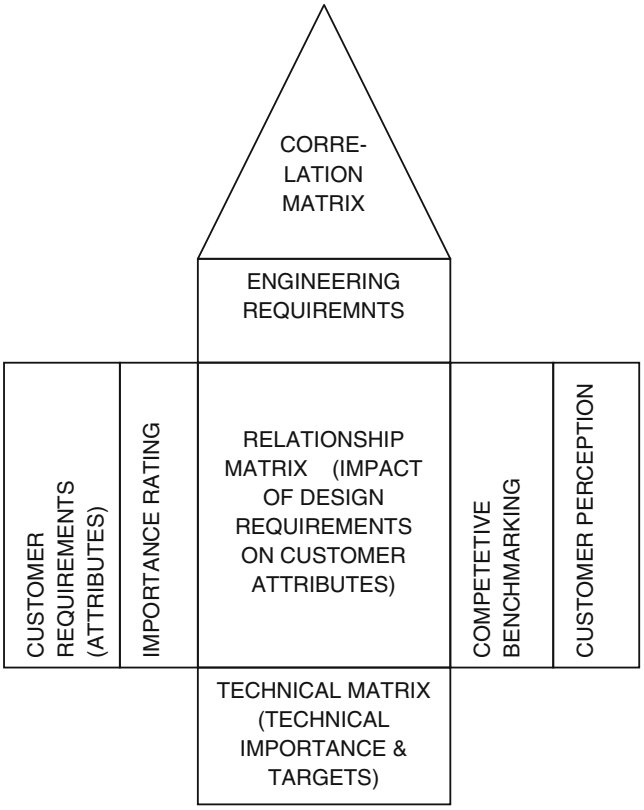

Fig. 1 The house of quality matrix

when they buy a new shaving razor. So customer satisfaction does not increase much if this attribute is present or improved very much but it will definitely make customer dissatisfied if not present or performance decreases.

The problem existing in traditional importance rating is that the customer usually gives more weight to 'must be' requirements if asked directly. This leads to decrease overall customer satisfaction because of negligence of innovative and attractive attributes. A theory that can help to identify different categories of requirements is Theory of 'attractive' quality and 'must be' quality (Kano's model). This model presents a framework for determination of importance value of customer requirements in such a way that it will lead to development of a product with innovative requirements with overall customer satisfaction [7].

4 Theory of attractive quality (Kano's model)

The customer is usually not able to accurately specify the desired product attributes in the real buying situation. With a simple questionnaire, only the tip of the iceberg and not the real needs of the customer are often identified [12]. Therefore, methodical support is necessary to clearly identify the relevant customer requirements. One method capable of identifying the core of the customer requirements is the Kano method. Kano introduced the theory of attractive quality. Based on theoretical foundations a two-dimensional model of quality attributes was presented. Further, a method was illustrated to use this theory in practice [6].

The theory of attractive quality proposes five dimensions of perceived quality (i.e., attractive, one-dimensional, must-be, indifferent and reverse quality). It evaluates these dimensions on the basis of the relationship between degree of fulfillment of a quality attribute and customer satisfaction with the quality attribute. For the last two decades, this theory is receiving attention of researchers and practitioners in strategic thinking, business planning, and product development to provide guidance with respect to innovation, competitiveness, and product compliance [11] (Fig. 2).

The different quality elements of the theory of attractive quality are as follows [6, 12, 16, 19]:

1. *Must-be requirements (M)*: must-be requirements are a decisive competitive factor, and if they are not fulfilled, the customer will be extremely dissatisfied and will not be interested in the product at all. On the other hand, as the customer takes these requirements for granted, their fulfillment will not increase satisfaction level significantly.
2. *One-dimensional requirements (O)*: in this category of requirements, customer satisfaction is proportional to the level of fulfillment of need—the higher the level of fulfillment, the higher the customer's satisfaction and vice versa. One-dimensional requirements are usually explicitly demanded by the customer.
3. *Attractive requirements (A)*: these requirements are the product criteria having the greatest influence on how satisfied a customer will be with a given product. Attractive requirements are neither explicitly expressed

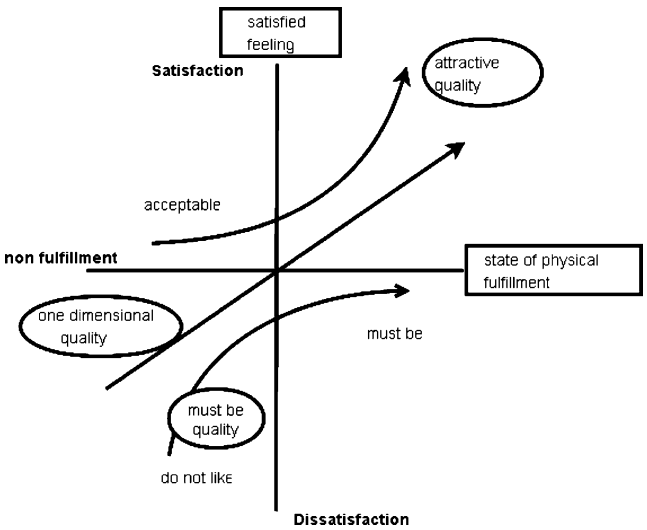

Fig. 2 Original Kano model [7]

nor expected by the customer. Fulfilling these requirements may lead to more than proportional satisfaction. However, there is no feeling of dissatisfaction if they are not met.

4. *Indifferent requirements (I):* this category means that the customer is not much interested in it, whether it is present or not.
5. *Reverse requirements (R):* this means that, not only do the customers not desire that product attribute, but they also expect the reverse of it.
6. *Questionable requirements (Q):* this rating indicates that either the question was phrased incorrectly, or the customer misunderstood the question, or an illogical response was given.

By using the Kano model and integrating it in the QFD the design team can enhance the understanding of customer needs, leading to superior product design. Researchers have shown keen interest to somehow reflect the understandings and results of the Kano model into QFD planning matrix, i.e., House of Quality. Kano model can be more accurately integrated into QFD for deciding the importance rating and prioritizing customer requirements so that a product or service can satisfy a customer more prominently and a competent product can be made available to the market.

5 Customer satisfaction coefficient

Customer satisfaction (CS) coefficients were proposed by Berger et al. [2] to show the quantitative values of satisfaction and dissatisfaction which comes by fulfillment or non-fulfillment of a requirement. The CS coefficient is indicative of how strongly a product feature may influence satisfaction or customer dissatisfaction in case of its "non-fulfillment". CS coefficients can be calculated by following formulas:

$$\text{Satisfaction index(SI)} = \frac{(\text{A}+\text{O})}{(\text{A}+\text{O}+\text{M}+\text{I})}$$

$$\text{Dissatisfaction index(DI)} = -\frac{(\text{M}+\text{O})}{(\text{A}+\text{O}+\text{M}+\text{I})}$$

a negative sign (−) shows that the value shows dissatisfaction. The value of these indexes can vary between 0 and 1. The positive CS coefficient ranges from 0 to 1; the closer the value is to 1, the higher the influence on customer satisfaction. A positive CS coefficient which approaches 0 signifies that there is very little influence. At the same time, however, one must also take the negative CS coefficient into consideration. If it approaches −1, the influence on customer dissatisfaction is especially strong if the analyzed product feature is not fulfilled. A value of about 0 signifies that this feature does not cause dissatisfaction if it is not met [14].

6 Integration of Kano's model into QFD

Some researches have suggested methods to integrate Kano's model into QFD. Matzler and Hinterhuber [12] have described the utilization of the customer satisfaction coefficient [2] as a supplementary tool in the QFD process. It is stated that the product should conform to expectations in basic requirements, be competitive in performance requirements and stand out regarding excitement requirements, but they do not describe methodology to integrate the results of the Kano model into QFD process.

Tan, K. C. and Shen, X. X. [16] proposed an approximate transformation function to adjust the improvement ratio of each customer requirement. Customers' raw priorities are thereby adjusted accordingly for achieving the desired customer satisfaction performance. The paper presented a method to integrate the Kano model in the QFD by introducing an adjustment in the traditional improvement ratio according to the equation:

$$\text{IR}_{\text{adj}} = (\text{IR}_0)^{1/k}$$

Where IR_{adj} is the adjusted improvement ratio, IR_0 is the traditional improvement ratio, and k is an adjustment factor. The value of k varies according to the Kano category. The Kano category has been found through the Kano questionnaire after giving brief knowledge of the Kano model to the customers. The final weight of a requirement is calculated by multiplying the raw importance by the adjusted improvement ratio. The authors have extended the options to define the values of k to the design team, but have suggested a set of values that may be 0.5, 1, and 2 for basic, performance and excitement requirements, respectively. In addition, the authors state that the *adjustment factor is valid only for these types of three requirements, not being applicable to other possible categories in the Kano model.* The proposal of Tan and Shen [16] increases the weight of basic requirements (k=0.5) and have decreased the weight of excitement requirements (k=2). This approach does not solve the problems that arise with the traditional importance rating.

Tan and Pawitra [17] proposed integration of the Kano model and SERVQUAL in the QFD by first determining the Kano category for each requirement. Then, multiplier values of 4, 2, and 1 are assigned to the excitement, performance and basic categories, respectively. Since, for non-innovative requirements, customers tend to find everything important [20], the multiplication of the SERVQUAL gap by the importance may not compensate for the resulting

low weight assigned to basic requirements in this method. It may lead a design team to underestimate criticality of basic requirements.

Tontini G. [18] presented a modified Kano Model questionnaire using a Likert Scale in order to identify the degree of satisfaction or dissatisfaction a certain requirement brings to the customers. Based on Berger et al. [2] CS coefficient, modified CS coefficients were introduced for using with the degree of satisfaction scale. Author has introduced an index RI (reverse index) apart with SI and DI. He used an adjustment factor $(1 + \max(|SI|, |DI|))$, where SI and DI are modified CS coefficients. Final importance has been calculated by multiplication of improvement ratio and this adjustment factor for each customer requirement.

Tontini G. [19] had proposed the use of the customer satisfaction coefficients [2] directly in the QFD house of quality (A-1 matrix). In this method, the importance column in the QFD A-1 matrix is replaced by following adjustment factor:

$$\text{Adjustment factor} = \text{Max}(|SI|, |DI|)$$

Where SI and DI are the satisfaction and dissatisfaction indexes [2]. The adjustment factor is the higher absolute value of SI or DI, putting more weight on the requirements that bring more satisfaction when present or that bring more dissatisfaction when absent. In this case, excitement, performance and basic requirements will be taken into consideration depending on the degree of satisfaction or dissatisfaction that they could bring to customers. A typical analysis determines that if (DI, SI) co-ordinates are drawn on a DI–SI plot [2, 18, 19]; different categories of requirements will be awarded same weightage. For example (0.75, 0.25) will fall under must-be category and (0.75, 0.65) will be under One-dimensional category. For both the cases, the value of adjustment factor will be same, i.e., 0.75 (max. of SI/DI) therefore both requirements will be given same importance which is not desirable.

7 Proposed approach

An approach which utilizes both important parameters resulting from Kano's theory can be used in a function to adjust the traditional improvement ratio (target/our own customer satisfaction level).This adjusted improvement ratio when multiplied by the self-stated importance will give final adjusted importance. The proposed function is:

$$IR_{adj} = (1 + m)^k \times IR_0$$

Where IR_{adj} is adjusted improvement ratio and IR_0 is traditional improvement ratio.$m = \max(|SI|, |DI|)$ and value of k is to be decided according to different Kano category which are found by DI–SI plot Tontini [18], value of k can be taken as 0, 0.5, 1, and 1.5 for indifferent, must-be, one-dimensional and attractive requirements, respectively.

The combination of the value of m and respective Kano category will give an adjustment factor that will finally adjust the original improvement ratio and multiplication of adjusted improvement ratio with self-stated importance results in final importance of customer requirements. In this function, attractive attributes has been given highest importance and indifferent as lowest importance. Kano parameter (k) for indifferent requirement is set as 0 which was not present in previous literatures. Indifferent requirements may be innovative in nature and initially when they are introduced, customer is indifferent to them. Kano [8] has explained that indifferent requirements can turn into attractive requirements in a lifecycle so they cannot be neglected at all. Attractive requirements should be given more weight due to modern customer's demand of innovative ideas and must-be requirements alone cannot make a competitively better product. Previously, Pawitra and Tan [13] have supported this but they have directly taken a multiplier to adjust final importance. According to Tan and Shen [16] products of attractive quality are desirable and customer expectation and satisfaction should be exceeded.

8 A case example

A case example is presented here to illustrate how the Kano model can be integrated to QFD by adjusting the improvement ratio in a better way and deciding final importance by proposed approach. The method is applied for finding the relative importance of different attributes of a "Good website design". An overview of the methodology used has been explained in Fig. 3 which is an integrated methodology of QFD and Kano model to decide final importance of attributes.

After careful information gathering and suggestions from daily Internet users, 12 attributes have been selected as requirements for good website design. A modified questionnaire [14] is prepared in which functional and dysfunctional questions for each attribute are asked. Customers are asked to rate the importance of particular attribute on a 1–5 scale where 1 is for minimum and 5 for maximum importance. This rating is taken as self-stated importance. It should be noted that customer is not asked to classify requirements in Kano category so the responders need not to have a prior knowledge of Kano's theory in this method. After evaluation of questionnaires (according to evaluation table of Lee and Newcomb [9]) frequency of different categories for each attribute is found and customer satisfaction coefficient SI and DI are calculated as shown in Table 1. Kano categories are decided according

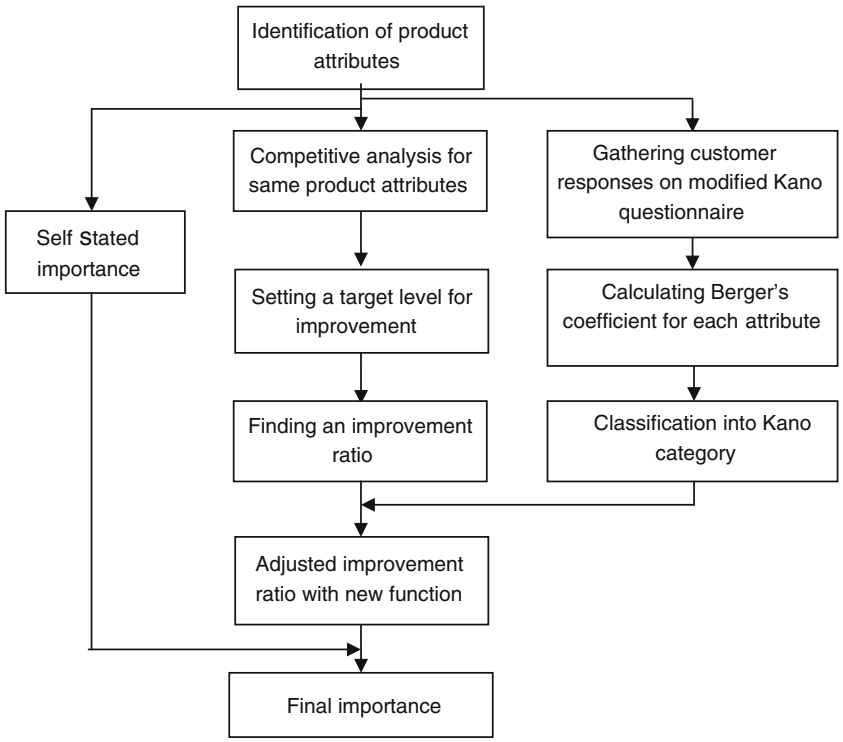

Fig. 3 Integrated process model to decide final importance of attributes

to SI, DI value of each CR and co-ordinates are taken as (DI, SI) as shown in Fig. 4.

Table 1 shows different customer requirements and the values of respective SI, DI and category evaluated according to the method stated above. The relative importance for each category evaluated by traditional method is given in Table 2.

In the proposed approach, requirements are classified into different Kano categories on the basis of how their fulfillment or non-fulfillment make customer satisfied or dissatisfied, respectively. The traditional improvement ratio is adjusted with proposed function so that proper weight can be given to attractive requirements. Table 3 shows adjusted improvement ratio and final importance of a requirement. It was seen that must-be requirements have higher self-stated importance than any other. It clearly depicts that customer many a times states about must-be requirement strongly and give higher weight to them if asked directly.

Table 1 SI, DI, and category of requirements

	Customer requirements	SI	DI	Category
1	Interesting web page	0.54	0.37	A
2	Reading of text	0.44	0.69	M
3	Uniform and standard page design	0.38	0.28	I
4	Sufficient information	0.41	0.71	M
5	Locating of information	0.53	0.59	O
6	Good linkages to other websites	0.65	0.29	A
7	Good integration of links	0.40	0.40	I
8	Fast loading	0.36	0.77	M
9	Use of flashes, animations	0.42	0.13	I
10	Multi language feature	0.36	0.06	I
11	Advertisements	0.07	0.07	I
12	Compatibility with cell phone	0.62	0.21	A

Self-stated importance value is the average of self-importance given by each customer for a particular attribute. The adjusted improvement ratio is calculated by proposed function using satisfaction and dissatisfaction index values and Kano category for corresponding values of k are shown in Table 1. Let us take an example that "Good linkages to other website" has highest relative importance and "Compatibility with cell phone" as second highest. Both the requirements are identified as attractive requirements as in Table 1. It can also be seen clearly that even when the self-stated importance for must-be requirements are higher, they have significantly less final importance and the results are supporting to current customer demands with an overall satisfaction because the customer always has some needs which he cannot express directly in words; the method also pointed out their unexpected but needed requirements in a new way.

Comparison with traditional method shows that the new approach is capable of providing more discrimination power to find which of the requirements are most important. As an example "Reading of text" which is a

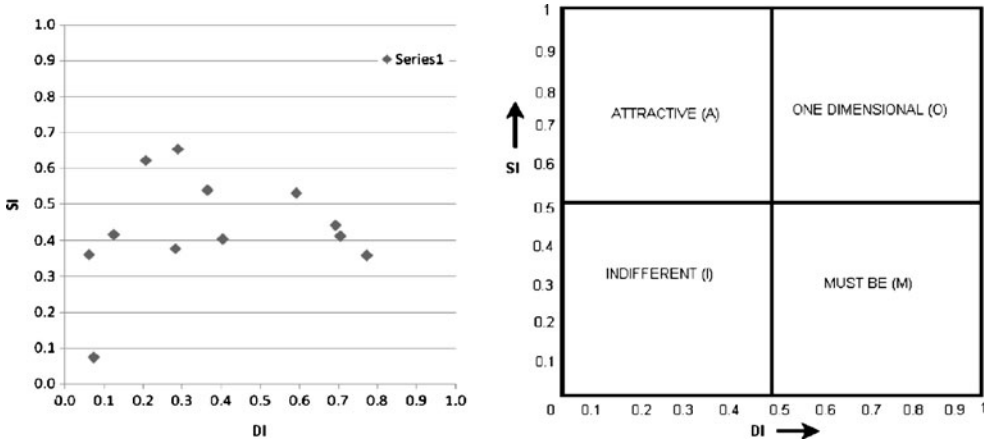

Fig. 4 Classification of requirements into Kano categories

must-be requirement in illustrated method has relative weight 9.31 whereas "compatibility with cell phone" has 15.51 but by traditional method it is 10.65 and 11.19, respectively, which seems to be almost equal. It should be noted that "reading of text" is identified as must-be requirement. Therefore, it should be fulfilled and should not be neglected.

9 Discussion

The results of a survey on "Good website design" attributes clearly shows the importance of integration of Kano's theory of attractive quality into QFD; prioritizing of customer requirements with this method can more accurately decide importance of requirements which will be an input to House of Quality matrix. Results depict that attractive requirements have relative weight more than must-be and one-dimensional requirement. It is interesting to see in self-stated importance column that everything is important to customer. The traditional method gives weight to all requirements with a standard deviation of 1.22 while the proposed method gives a standard deviation 3.71 for the values of final importance, so the discrimination power inherited in the proposed approach is larger and it is easy to identify the importance of requirement.

An important addition is the consideration of indifferent requirements for adjustment in improvement ratio, value of

Table 2 Relative importance with traditional method

Customer requirements	Self-stated importance	category	Our web page	Competitor 1	Competitor 2	Target	Improvement ratio	Adjusted importance	Relative importance
Interesting web page	3.80	A	2	2	3	3	1.50	5.70	9.46
Reading of text	4.11	M	2	3	3	3	1.50	6.17	10.24
Uniform and standard page design	3.20	I	4	3	4	4	1.00	3.20	5.31
Sufficient information	4.25	M	3	4	3	4	1.33	5.67	9.41
Locating of information	4.28	O	4	3	5	4	1.00	4.28	7.11
Good linkages to other websites	3.20	A	2	3	4	4	2.00	6.40	10.63
Good integration of links	3.51	I	3	2	4	4	1.33	4.68	7.77
Fast loading	4.70	M	3	4	2	4	1.33	6.27	10.40
Use of flashes, animations	3.25	I	4	3	4	5	1.25	4.06	6.74
Multi language feature	3.00	I	3	2	3	4	1.33	4.00	6.64
Advertisements	2.22	I	2	3	1	3	1.50	3.33	5.53
Compatibility with cell phone	3.70	A	2	3	4	4	1.75	6.48	10.75

Table 3 Final importance of requirements with proposed approach

Customer requirements	Self-stated importance	Category	m=max (SI,DI)	Our web page	Competitor 1	Competitor 2	Target	Improvement Ratio	Adjusted improvement Ratio	Adjusted importance	Relative importance
Interesting web page	3.80	A	0.54	2	2	3	3	1.50	2.86	10.88	12.63
Reading of text	4.11	M	0.69	2	3	3	3	1.50	1.95	8.02	9.31
Uniform and standard page design	3.20	I	0.38	4	3	4	4	1.00	1.00	3.20	3.72
Sufficient information	4.25	M	0.71	3	4	3	4	1.33	1.74	7.40	8.60
Locating of information	4.28	O	0.59	4	3	5	4	1.00	1.59	6.81	7.91
Good linkages to other websites	3.20	A	0.65	2	3	4	4	2.00	4.25	13.61	15.81
Good integration of links	3.51	I	0.40	3	2	4	4	1.33	1.33	4.68	5.44
Fast loading	4.70	M	0.77	3	4	2	4	1.33	1.78	8.35	9.69
Use of flashes, animations	3.25	I	0.42	4	3	4	5	1.25	1.25	4.06	4.72
Multi language feature	3.00	I	0.36	3	2	3	4	1.33	1.33	4.00	4.65
Advertisements	2.22	I	0.07	2	3	1	3	1.50	1.50	3.33	3.87
Compatibility with cell phone	3.70	A	0.62	2	3	4	4	1.75	3.61	13.35	15.51

k=0 for indifferent (I), k=0.5 for must-be (M), k=1 for one-dimensional (O), k=1.5 for attractive (A)

k which is proposed as 0 (zero) for the function, that was not applicable in Tan and Shen [16]. Although the least importance is given to them but still they cannot be neglected because as discussed by Kano [8] about the life cycle of attributes that an attribute generally become attractive after indifferent phase, so it is an appreciable idea to improve them.

A life cycle analysis for attributes is also made and results are supportive to the previous theories. For example, "fast loading of website" was a one-dimensional requirement in Tan and Shen [16] which has been found as a must-be requirement through this survey. Another interesting life cycle change can be seen in the attribute "Good integration of links". This was a must-be requirement in Tan and Shen [16] which has now been found as indifferent requirement to users. This suggests a complete life cycle of attributes that after passing through indifferent, attractive, one-dimensional and must-be phase, an attribute may become indifferent to customer as it has completed its life cycle and customer thinks no more about whether it is present or not (Table 4).

The function proposed here is practically applicable and reliable. The function has been theoretically tested for pattern of improvement ratio plot with the different values of m and k. Let the (DI, SI) co-ordinates of three attributes be (0.60, 0.40), (0.60, 0.60), and (0.40, 0.60). It can be easily interpreted by DI–SI plot [18] that attributes are must-be, one-dimensional and attractive, respectively. The function proposed for adjusted improvement ratio wisely gives more importance to attractive requirement even when the value of m is the same for all requirements. This implies that even when the satisfaction index is equal to dissatis-

Table 4 Comparison of life cycle of attributes

	Attributes	Tan and Shen [16]	Proposed work
1	Interesting web page	O	A
2	Reading of text	M	M
3	Uniform and standard page design	O	I
4	Sufficient information	M	M
5	Locating of information	O	O
6	Good linkages to other websites	A	A
7	Good integration of links	M	I
8	Fast loading	O	M
9	Use of flashes, animations	–	I
10	Multi language feature	–	I
11	Advertisements	–	I
12	Compatibility with cell phone	–	A

faction index, the improvement factor for hidden or innovative features should be higher to lead the market, retain product value, and demand in the increasing competitive environment.

10 Conclusion

Quality function deployment has been a successful methodology to translate voice of customer into final product specifications; thus, an important method of product development for a long time. The traditional QFD approach uses importance ratings and customer satisfaction with the company's product and its competitors to establish priorities among customer requirements and deploy them in the design process. After identifying unexpected and unspoken features, which can be attractive to the customer, the Kano model of customer satisfaction can be successfully integrated to prioritize customer importance with the help of the proposed function.

The proposed approach assigns higher importance to those requirements that give either more satisfaction or dissatisfaction. The approaches used in the past gave importance to either customer satisfaction index or the class of requirement. The present approach considers the combined value of improvement ratio and integrates it with QFD matrix so that developed product will have attractive features without neglecting primary requirements.

The integration of the Kano model with QFD provides a mean for organizations to delight customers by including their voice into the product design process. The application of the Kano model is useful for better discrimination of customer needs whereas its integration in QFD matrix will help product designers to decide most important product development activities and to achieve maximum customer satisfaction.

The major limitation of this research is that it may prove difficult to apply this approach on a totally new product which is not already introduced in the market. In such conditions, customers will be unaware with different aspects of product and survey results will be irrelevant. Further, cost of fulfillment of need many a times hinder the overall satisfaction of customers. Product and development costs are not considered in this research.

For further researches, a cost model can be developed which will be helpful to allocate the budget according to their classification and final importance. In further research, this method may be applied in a product development project considering cost as a constraint and then to identify the cost which should be incurred for each of the attribute.

Finally, this work analyzed the limitations of methods published in the literature for integration of the Kano model in the QFD and proposed an alternative one. The proposed function can more precisely adjust improvement ratio to decide final importance of customer requirement with improved discrimination power. A life cycle analysis of attribute showed that attributes generally pass through different particular phases from their introduction to end. Though the proposed method has a good capability to understand the customer requirement and suggesting the importance level of them but results of the method should be applied to a project only after a thoughtful process to derive maximum benefit through the process.

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