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The Concept of Kano-QFD Integration for Non-linear Customer Needs in Product and Service Design

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Abstract – *High quality of product and service is always demanded by customers. Conversely, poor quality of product and service will result with customer dissatisfaction. However, this linear relationship is no longer accurate due to the complexity nature of customer needs. Non-linear relationship should be considered for more accurate evaluation of customer needs. This paper presents a concept of Kano model and Quality Function Deployment (QFD) integration to evaluate the non-linearity of customer needs towards the quality of products or services. By a case study, the developed Kano-QFD model is validated with the theory of Kano model and found to have well agreement. Further application for product development is recommended for future research.*

Keywords: Kano Model, Quality Function Deployment, Nonlinear Needs, Customer Dissatisfaction

1.0 INTRODUCTION

Customer satisfaction is assumed to be increased as the service or product quality is increased. Conversely, customer dissatisfaction is assumed to increase as the service or product quality decreased. This linear relationship is always considered in most of studies [1]. However, linear relationship assumption may be slightly inaccurate to describe the customer fulfilment because high level of customer satisfaction might not indicate high service or product quality with exceed customer fulfilment and expectation on the service delivery or product specification [2]. Non-linear relationship need to be considered for better accuracy of customer fulfillment. Non-linear assessment of customer satisfaction for product development is growing in research but lack of study for service design and development. Therefore, this study aims to develop a non-linear integration model using Kano model and Quality Function Deployment (QFD) for service design purposes before apply to product development. Healthcare service industry is selected as a case study due to high complexity of patient needs in healthcare service delivery design before can be apply to product design.

In case study of healthcare service, the complexity behaviour of patients cannot be assessed by linear relationship approach, it has cause underestimate patient satisfaction [3] and dissatisfaction [4]. At present, research to explain service delivery and patient fulfilment based on nonlinear relationship in a form of service quality attributes is still new [5]. According to Matzler *et al*. [6], the relationship between service delivery attribute level performance and patient satisfaction or dissatisfaction should be treated as non-linear.

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Moreover, the actual patient satisfaction level is complex [7] and it need to be considered in any healthcare modelling [8] as nonlinear relationship [9]. Patient satisfaction and patient dissatisfaction should not always have linear relationship with service quality performance where unspoken, hidden and uncertain complaints and compliments may be neglected. To date, lack of service satisfaction models that attempt to explain the nonlinear behaviour of satisfaction and dissatisfaction in healthcare service. This study focuses on Doctor Care service.

2.0 DEVELOPMENT OF KANO-QFD INTEGRATION

In present work, a set of equivalent answer is needed to be defined further to match the service satisfaction scale in Kano-QFD integration. Figure 1 shows the developed Kano-QFD integration house.

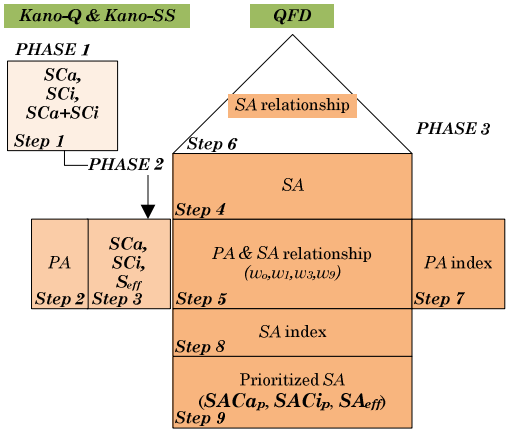

Figure 1: Kano-QFD Integration

The proposed Kano-SS answer is relatively based on basic Mikulic and Prebezac [10] assumption that has been used in critical incident technique (CIT) and analysis of complaints and compliments (ACC) in Kano Model. The assumption addresses that quality attributes can be categorized by comparing how frequently customers mention an attribute in positive context or a negative context. CIT is a qualitative technique that was proven its efficiencies in defining quality attributes based on complaints and compliments [11, 12]. In relating the ACC and CIT rules to existing Kano quality attributes (KQA) definition, the Kano-SS answer equivalencies are reasonable in numbers or frequency basis. Based on the above rules, in order to validate the Kano-SS answer, the original Kano questionnaire which asked in 10 primary questions are need to be in condition of summation of A and O, and they must always exceeds or equal to the summation of M and I, if not the Kano-SS answer likely not truly valid and have no compliance with Rule 1, 2 and 3. The above expression can be defined as:

$$\sum_{i=1}^{n} A_i + \sum_{i=1}^{n} O_i \geq \sum_{i=1}^{n} M_i \text{ or } \sum_{i=1}^{n} I_i \quad (1)$$

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where n is total numbers of respondents and i is the number of KQA results based on Kano evaluation table. If the above rule is fulfilled, then the Kano-SS answer can be applied for the rest of secondary questions which consist of modified Kano questions.The dysfunctional question part of Kano-SS answer also required further definition, if not; the quality attribute cannot be justified. The complaining behaviour by Matzler *et al.* [13] mentioned that the pattern of attributes performance in research particular setting might due to service perform very well in some areas and very poorly in others. This statement elucidated that the pattern or trend of contrast scale in satisfaction behaviour assessment is realistic. This is another validation test, if succeed, theoretically the Kano-SS can be employed for dysfunctional type of question.

$$\sum_{i=1}^{n} M_i \text{ or } \sum_{i=1}^{n} O_i >> \sum_{i=1}^{n} A_i \text{ or } \sum_{i=1}^{n} I_i \quad (2)$$

where n is total numbers of respondents and i is the number of KQA results based on Kano evaluation table. The new set Kano-QFD questionnaires were answered by 300 respondents.

3.0 RESULTS AND DISCUSSION

Berger's Coefficient and Kano Quality Attributes. It is found that the KQA is mostly dominated by Must-be (M) requirements attribute followed by One-dimensional (O) attribute. Orderly, eight SV are identified in the order of M > O > I > A > R > Q while two SV are demonstrated in O > M > I > A > R > Q. It means, the patient may easily take for granted for any undelivered service, but result with dissatisfaction when not fulfilled. Table 1 shows the KQA frequency and KQA category based on the respective Berger's coefficient for Doctor Care service variables. Overall, it can be seen that all Patient Attributes (PA) DCQ3-DCQ11 have resulted with different KQA frequency. This is the preliminary results of Phase 1 Kano-QFD. The KQA category of A, M, O, I and Q are appeared to be the class of PAs where the R category has zero frequency.

Table 1: Kano-SS KQA for Doctor Care

Doctor Care	Kano Quality Attributes (frequency)						∑	Berger's coefficient		KQA
	A	M	O	I	R	Q		SS_{ss}	SD_{ss}	
DCQ3: High quality of work	56	132	38	72	0	2	300	0.32	-0.57	M
DCQ4: Knowledge and skill	57	145	37	59	0	2	300	0.32	-0.61	M
DCQ5: Inspection and treatment	46	147	36	68	0	3	300	0.28	-0.62	M
DCQ6: Medical technique	64	127	36	69	0	4	300	0.34	-0.55	M
DCQ7: Pain & comfort	54	127	33	83	0	3	300	0.29	-0.54	M
DCQ8: Checking & record	57	136	35	69	0	3	300	0.31	-0.58	M
DCQ9: Medical instrument	57	132	43	66	0	2	300	0.34	-0.59	M
DCQ10: Calm & patient	56	123	45	70	0	6	300	0.34	-0.57	M
DCQ11: Efficient and effective	49	133	31	82	0	5	300	0.27	-0.56	M

That means, no respondents think that the absent of DCQ3-DCQ11 will affect the satisfaction or presence of DCQ3-DCQ11 have no effect to satisfaction. It can be observed, the frequency of KQA is in a form of M > A > I > O > Q where the frequency of M appeared to be the highest. The highest frequency of KQA will be the final category of KQA for every measured attributes. Therefore, all the PA attributes for Doctor Care is resulted as M category. That means, majority of respondents or patients expected all the DCQ3-DCQ11 as compulsory. It also translated that the patients may feel dissatisfied if the quality attributes DCQ3-DCQ11 are unfulfilled. The more insufficient attributes the more patients' dissatisfaction. The indifferent I attribute is the second highest. It means, some patients felt the fulfillment of quality attributes DCQ3-DCQ11 will result in neither service satisfaction nor service dissatisfaction. Most important, the attractive attribute A is the third highest frequency. This frequency highlighted that some patients not really expected the fulfillment of DCQ3-DCQ11 but if those quality attributes are fulfilled, the patients can be exciting and really satisfied. Inversely, if the attributes are unfulfilled, the patients cannot be dissatisfied but accept its absence. This attributes are often unspoken to patients. Moreover, the Berger's coefficient shows that the dissatisfaction coefficient is relatively higher than satisfaction coefficient

Kano-QFD House of Quality. The ranking and priorities of patient attributes (PA) and service attributes (SA) is presented in Step 7 and Step 9 of Kano-QFD integration. The expected results are in four categories; prioritized PAs by compliments ($PACi_p$) index for Doctor Care, prioritized PAs by complaints ($PACa_p$) index for Doctor Care, prioritized SAs by compliments ($SACi_p$) index for Doctor Care and prioritized SAs by complaints ($SACa_p$) index for Doctor. It is found that the ranking of $PACi_p$ and $PACa_p$ for Doctor Care based on absolute weight (w) and percentage (%) of compliments and complaints, respectively. It can be observed that the absolute weight (w) for ($PACi_p$) varies from 31.68 - 86.92 which is lower than $PACa_p$ that varies from 44.64 - 133.56. This absolute weight (w) range represents the impact of satisfaction and dissatisfaction through compliments and complaints. In general, the satisfaction level is slightly lower than dissatisfaction level. Table 2 - 3 show the prioritized service attributes by compliments ($SACi_p$) and complaints ($SACa_p$) index for Doctor Care based on top 5 ranking SA out of 44 service attributes (SA). It can be seen that "Code of practise" has been the 1st ranking for $SACi_p$ and $SACa_p$. The present Doctor Care findings are closely agreed with study of patient complaint [14] and compliment [15] in related to doctor service. It is found that the patient expectations are different from those planned medical assistance.

Table 2: Prioritized service attributes ($SACi_p$) index by compliments for Doctor Care

Rank	%	*w*	Service attributes (SA)	SA categories
1	6.4	3969.4	Code of practise	Med. serv. delivery & tech. care
2	6.0	3684.3	Standardization of diagnosis	Medical service organizations
3	6.0	3683.1	Staff knowledge & experience	Healthcare education
4	6.0	3672.2	Medical apparatus used	Med. serv. delivery & tech. care
5	5.5	3385.5	Degree of attentiveness	Med. serv. delivery & tech. care

Table 3: Prioritized service attributes ($SACa_p$) index by complaints for Doctor Care

Rank	%	*w*	Service attributes (SA)	SA categories
1	6.4	5948.1	Code of practise	Med. serv. delivery & tech. care
2	6.0	5519.4	Medical apparatus used	Med. serv. delivery & tech. care
3	6.0	5513.4	Standardization of diagnosis	Medical service organizations
4	5.9	5482.8	Staff knowledge & experience	Healthcare education
5	5.4	5036.2	Degree of attentiveness	Med. serv. delivery & tech. care

Based on the rank 1-4 for for $SACi_p$ and $SACa_p$, in conjunction with for $PACi_p$ and $PACa_p$ ranking, it can be concluded that patient's give high value to the care they receive from Doctor, as major healthcare personnel. In the context of physician primary care, caring behavior with the knowledge, skills and ethics as a caregiver has been directly acknowledged and demand by patients, which finally contributed to satisfaction and dissatisfaction of patients [16].

4.0 CONCLUSSION

The execution of Kano-QFD integration for healthcare service specifically applies for Doctor Care has been successfully tested. The new Kano-SS element that has been embedded in the original Kano model [17] found to be satisfied for assessing non-linearity needs and behavior of customer or patients. The complexity of customer needs and fulfillment can be evaluated into Kano Quality Attribute (KQA). However, the matrix operation of Kano-QFD needs further improvement for better accuracy of KQA assessment. As a conclusion, the new Kano-QFD model is successfully developed and ready for product design and development application.

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