Kano's Model for Clinical Laboratory

Khaled N. El-Hashmi, Omar K.Gnieber

Abstract—The clinical laboratory has received considerable recognition globally due to the rapid development of advanced technology, economic demands and its role in a patient's treatment cycle. Although various cross-domain experiments and practices with respect to clinical laboratory projects are ready for the full swing, the customer needs are still ambiguous and debatable. The purpose of this study is to apply Kano's model and customer satisfaction matrix to categorize service quality attributes in order to see how well these attributes are able to satisfy customer needs. The result reveals that ten of the 26 service quality attributes have greater impacts on highly increasing customer's satisfaction and should be taken in consideration firstly.

Keywords—Clinical laboratory, Customer satisfaction matrix, Kano's Model, Quality Attributes, Voice of Customer.

I. INTRODUCTION

THE customer satisfaction constitutes a cardinal indicator for assessing the success of an enterprise. Zingheim and Schuster [7] asserted about the successful of financial performance and business growth due to the listening customer input in decision processes in which they are formulated to encourage the innovation and creativity directed to the development of new or enhanced products and services.

Strategic significance of customer satisfaction has been realized by healthcare industry like the case in other services sectors in recent years. To fill the gaps between customer perceptions and expectations about the service received is vital for customer satisfaction. As Matzler and Hinterhuber [5] stated more and more firms use satisfaction ratings as an indicator of the performance for services and consequently an indicator of the company's future. Since service quality is a vital element in creating customer satisfaction, it also plays an important role in sustaining profit levels of companies. As a result, the measurement of service quality deserves special attention.

A difficulty arises from the different assumptions about linearity of relationship between service quality and customer satisfaction. Traditional methods assume a linear relationship which can be explained as: the more the service level increases, the more customer satisfaction is achieved [2], [4]. However, an increasing number of researchers under the leadership of Kano et al. [6] contradict the idea of a linear and symmetric relationship and claim that in some cases this relationship may also exhibit a non-linear pattern. So, Kano

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classified the service quality attributes according to their effects on customer satisfaction. Such an approach provides a main guide for strategic and tactical decisions made by companies to achieve customer satisfaction.

One of the most important units of the healthcare sector, particularly in hospitals, is undoubtedly clinical laboratories. Obviously, without accurate test results, physicians cannot make diagnoses or provide effective treatment. This is true even for experienced physicians. Currently, clinical laboratories affect 60~70% of all critical decisions, such as the admission, discharge, and drug therapy of patients [9]. Coskun et al. [1] believe that this rate is even higher. Despite these vital functions, in the healthcare sector, laboratory costs are a very low proportion (5~10%) of the total cost of patient care [9].

Despite the vital functions of clinical laboratories, healthcare managers have not paid adequate attention to them. In addition, healthcare administrators frequently manipulate laboratories. These interventions decrease the diagnostic and competitive power of laboratories relative to other medical services [1].

The objective of this research is to apply a Kano's model to classify clinical laboratory quality attributes into four categories, namely, *"Attractive", One-dimensional", "Must-be", and "Indifferent"*, based on voice of customer [6]. By adopting the customer satisfaction coefficient developed by Matzler and Hinterhuber [5], these strategies can be further quantified to establish a customer satisfaction matrix for evaluating satisfied and unsatisfied preferences.

II. THE KANO'S MODEL

As Shen et al. [12] stated a deep understanding of customer needs and expectations is a pre-requisite to achieving customer satisfaction. At this point, in the late 1970s Professor Noriaki Kano of Tokyo Rika University and several colleagues from Japan developed the Kano model in order to define service quality in the context of customer needs [3]. However, many of the previous definitions of quality, including that of Hertzberg, were linear and one-dimensional in nature. Here, linearity term represents that customer satisfaction is supposed to increase (or decrease) more or less linearly when the level of any service attributes is improved (or weakened) [4]. However, Kano et al. [6] contradicted this traditional view and proposed a non-linear and two-dimensional (the degree to which a service performs, the degree to which the customer is satisfied) quality. They suggested that sometimes service attributes may exhibit a non-linear pattern and because of this non-linearity, perceived service quality attributes may not always create the expected satisfaction or may cause dissatisfaction.

The Kano two-dimensional quality model is a useful tool to classify and prioritize customer needs. It can also address the non-linear relationship between quality attributes performance of a product (or service) and overall customer satisfaction [6]. These quality attributes, as shown in Fig. 1, can be classified into four categories: (1) *must-be* attributes are expected by the customers and will result in dissatisfaction when these attributes are not fulfilled; (2) *one-dimensional* attributes are those for which better fulfillment leads to linear increment of customer satisfaction; (3) *attractive* attributes are usually unexpected by the customers and can result in great satisfaction if they are available; and (4) *indifferent* attributes are those that the customers is not interested in the level of their performance [3], [5], [6]. By adopting this Kano's model, customer needs, such as preferences of clinical laboratory quality attributes, can be effectively classified and identified.
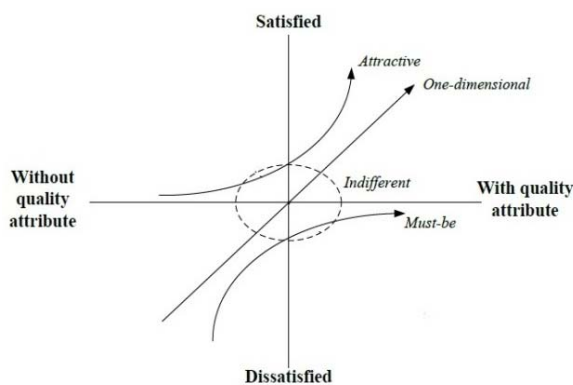

Fig. 1 the Kano's model

III. METHODOLOGY

A clinical laboratory of Benghazi Medical Center (BMC) a largest hospital in Benghazi city, a city situated in the north-east of Libya has been chosen to carry out the empirical analysis.

The research methodology was designed to take into account the main goals of this study and is specified as, categorizing BMC clinical laboratory quality attributes using the Kano's model and develop customer satisfaction matrix to quantitatively reflect the priority of adopting these quality attributes.

The sample for this study was selected from BMC clinical laboratory outpatient. Primary data were collected from the hospital's outpatients by establishing a questionnaire. The questions can be seen at Table I. The questionnaire consists of positive/functional and negative/dysfunctional attributes. The outpatient can answer a pair of questions in one of five different ways, "Like", "Must-be", "Neural", "Live with", and "Dislike" for each service quality attribute. The first question concerns the reaction of the customer if the service has that attribute (functional form); the second involves the reaction if service does not have that attribute (dysfunctional form) [5].

The first step involves the adoption of the service quality scale to the healthcare sector. After examination of the literature concerning healthcare service quality, 26 attributes were used in Kano's model questionnaire (see Table I). At this point, in order to provide content validity of the scale, two Section Chief at BMC clinical laboratory were interviewed independently. Also, the scale was pre-tested by twenty outpatients to check for understandability.

TABLE I
THE 26 QUALITY ATTRIBUTES

No.	Attributes
Tangibles	
T1	Utilizing up-to-data equipment.
T2	Appealing physical facilities.
T3	Well dressed and appear neat employees.
T4	The visually appealing materials associated with the service.
T5	Clean and comfortable environment of the Lab.
Reliability	
R1	Providing their services at the time they promised to do so.
R2	Fast service providing.
R3	Maintain error-free records (accurate records).
R4	Carrying out of the services right at the first time.
Responsive	
Re1	Willingness of personnel to help patients.
Re2	Attending of personnel whenever called.
Re3	Showing a sincere interest in solving patients problems.
Re4	Being sympathetic and reassuring with patients problems.
Re5	Telling patients exactly when services will be performed.
Re6	Prompt performance of medical and non-medical services.
Assurance	
A1	Feeling safe in patient's interactions with Lab employees.
A2	Having knowledge to answer patients' questions.
A3	Employees are polite.
A4	Employees have adequate support from their employers.
A5	Instilling confidence in patients.
Empathy	
E1	Given individual attention to patients.
E2	Dealing with patients in a caring fashion.
E3	Availability of 24-hours services.
E4	Having convenient operating hours to all Labs' patients.
E5	Understanding specific needs of patients.
E6	Having their patient's best interests at heart.

Second, the questionnaire is deployed to 150 outpatients, and each answer pair is aligned with the Kano evaluation table [3], as shown in Table II, which can reveal each outpatient's perception toward attributes of a service [8], [10]. If the customer answers, for example, "I like it that way" as regards a specific attribute from the functional side, and answers "I am neural" for the same attribute from the dysfunctional side, the combination of the question in the evaluation table will be the category of "A", indicating that this attribute is attractive to customer needs.

TABLE II
KANO EVALUATION TABLE

		Dysfunctional				
		Like	Must-be	Neural	Live with	Dislike
Functional	Like	Q	A	A	A	O
	Must-be	R	I	I	I	M
	Neural	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	Q

Note: Q, A, R, I, O, and M denote "Questionable", "Attractive", "Reverse", "Indifferent", "One-dimensional", and "Must-be" attributes, respectively.

Third, the use of the customer satisfaction coefficient (CSC), as show in (1) and (2), is applied to understand how strongly a quality service attribute may affect satisfaction or, in the case of its non-fulfillment, customer dissatisfaction. The positive CSC ranges from 0 to1. The closer satisfaction coefficient (SC) value is to 1, the higher the influence on customer satisfaction. On the contrary, if the dissatisfaction coefficient (DSC) approaches 1, the influence on customer dissatisfaction is especially strong if the attribute of the service is not fulfilled. A value of 0 implies that this attribute has low influence which does not cause dissatisfaction if it is not met [5].

$$SC = (A + O)/(A + O + M + I) \qquad (1)$$

$$DSC = (O + M)/(A + O + M + I) \qquad (2)$$

IV. DATA ANALYSIS

Each service quality attribute which were assigned by the respondents was analyzed through frequency analysis. As Matzler and Hinterhuber [5] stated, the simplest method is to use frequency of answers for evaluation and interpretation goals. So, in defining the characteristic of every service attributes, the service attribute category which has the highest frequency among four categories is selected as identifier. The results of the analysis are shown on Table III.

The questionnaire was tested by the internal consistency based on the notion of the Cronbach's α reliability coefficient. The results show that the average coefficient for the outpatient is 0.833, above the benchmark of 0.7 suggested by Nunnally [9], interpreting that the proposed questionnaire has a high reliability suitable for data analysis. The quality attribute for BMC clinical laboratory and its corresponding SC / DSC are illustrated in Table III.

Microsoft Excel software was utilized for both data input and analysis.

TABLE III
RESULTS OF THE KANO'S MODEL

Attributes	M	O	A	I	Classify	SC	DSC
T1	9.3%	20.7%	18.7%	51.3%	I	0.39	0.30
T2	15.3%	14.7%	29.3%	40.7%	I	0.44	0.30
T3	18.7%	25.3%	18.7%	37.3%	I	0.44	0.44
T4	9.3%	29.3%	9.3%	52.0%	I	0.39	0.39
T5	9.3%	45.3%	25.3%	20.0%	O	0.71	0.55
R1	5.3%	54.7%	20.0%	20.0%	O	0.75	0.60
R2	14.7%	36.0%	30.0%	19.3%	O	0.66	0.51
R3	36.0%	28.0%	26.7%	9.3%	M	0.55	0.64
R4	10.7%	46.0%	34.0%	9.3%	O	0.80	0.57
Re1	9.3%	20.0%	15.3%	55.3%	I	0.35	0.29
Re2	9.3%	20.0%	40.0%	30.7%	A	0.60	0.29
Re3	21.3%	24.7%	20.0%	34.0%	I	0.45	0.46
Re4	20.0%	15.3%	25.3%	39.3%	I	0.41	0.35
Re5	20.7%	25.3%	34.0%	20.0%	A	0.59	0.46
Re6	20.7%	24.7%	42.0%	12.7%	A	0.67	0.45
A1	14.7%	30.7%	10.7%	44.0%	I	0.41	0.45
A2	20.0%	24.7%	40.0%	15.3%	A	0.65	0.45
A3	15.3%	54.7%	15.3%	14.7%	O	0.70	0.70
A4	14.0%	21.3%	20.0%	44.7%	I	0.41	0.35
A5	25.3%	19.3%	20.7%	34.7%	I	0.40	0.45
E1	18.7%	44.7%	21.3%	15.3%	O	0.66	0.63
E2	14.7%	20.0%	25.3%	40.0%	I	0.45	0.35
E3	15.3%	15.3%	60.0%	9.3%	A	0.75	0.31
E4	24.7%	10.0%	46.0%	19.3%	A	0.56	0.35
E5	24.7%	24.0%	21.3%	30.0%	I	0.45	0.49
E6	20.0%	15.3%	25.3%	39.3%	I	0.41	0.35

V. RESULTS AND DISCUSSIONS

According to the result shown in Table III, several findings with respect to the customer's preferences and satisfaction for BMC clinical laboratory are worth further discussion.

A. Outpatient Requirements for BMC Clinical Laboratory

As can be seen in Table III, six of the total 26 service quality attributes (Re2, Re5, Re6, A2, E3, and E4) have been categorized as "attractive". Six service quality attributes (T5,

R1, R2, R4, A3, and E1) have been categorized as "*one-dimensional*", and thirteen of them (T1, T2, T3, T4, Re1, Re3, Re4, A1, A4, A5, E2, E5, and E6) as "*indifferent*". However, there is just one service quality attribute can be categorized as "*must-be*". This finding is parallel with other studies. None of the nineteen service quality attributes took a place in the "must-be" in Pawitra and Tan's study [11]. Similarly, Chen and Su [13] stated that none of the 29 service quality variables could be placed in this category. However, offering customers "must-be" or expected quality attributes will not be enough for customer satisfaction in today's contemporary world [12].

For some service quality attributes related to reliability dimension of service quality, such as "R1 providing their services at the time they promised to do so", "R2 fast service providing", and "R4 carrying out of the services right at the first time", are considered as "*One-dimensional*" attributes, revealing that outpatient satisfaction is proportional to level of performance of these attributes.

Attributes focusing on service quality responsive dimension, such as "Re2 attending of personnel whenever called", "Re5 telling patients exactly when services will be performed", and "Re6 prompt performance of medical and non-medical services", are classified into "*Attractive*" attributes. The finding discloses that these attributes are more explicit and fulfilling these requirements leads to more than proportional satisfaction. If they are not met, however, there is no feeling of dissatisfaction. The reason might be that customers have an intimate knowledge of these attributes. Without adopting these attributes, customers can still find other alternative solutions to fulfill their requirements.

Several attributes of some service quality dimensions, such as "T1 utilizing up-to-data equipment", "T2 appealing physical facilities", "T3 well dressed and appear neat employees", "T4 the visually appealing materials associated with the service", "Re1 willingness of personnel to help patients", "Re3 showing a sincere interest in solving patients problems", "Re4 being sympathetic and reassuring with patients problems", "A1 feeling safe in patients interactions with Lab employees", "A4 employees have adequate support from their employers to do their jobs well", "A5 instilling confidence in patients", "E2 dealing with patients in a caring fashion", "E5 understanding specific needs of patients", and "E6 having their patient's best interests at heart", are classified as "*Indifferent*" attributes. The reason might be that the benefits and advantages of these attributes are not easily perceived by customers, and therefore they do not result in either customer satisfaction or dissatisfaction.

B. Customer Satisfaction Matrix

Based on the concept of CSC, a customer satisfaction matrix can be developed to quantitatively reflect the priority of adopting these attributes of clinical laboratory. This matrix, depicted in Fig. 2, is comprised of four quadrants divided by an X-axis, representing the level of satisfaction, and a Y-axis, representing the level of dissatisfaction.

The origin of this matrix is the average of SC and DSC. Strategies located in the quadrant I, therefore, imply that these strategies have greater impacts on highly increasing customer's satisfaction and dissatisfaction and should be implemented firstly. Strategies in the quadrant III, on the contrary, could be suspended due to their low influence on customer's satisfaction and dissatisfaction. Considering the efficiency of budget utilization, decision-makers can decide whether they would like to invest in strategies located in quadrant II and IV since these strategies can only improve either customer's satisfaction or customer's dissatisfaction and do not have much effect upon the result.

The observation from Fig. 2 reveals that the priority would be given to the attributes of "T5 clean and comfortable environment of the Lab", "R1 providing their services at the time they promised to do so", "R2 fast service providing", "R3 maintain error-free records (accurate records)", "R4 carrying out of the services right at the first time", "Re5 telling patients exactly when services will be performed", "Re6 prompt performance of medical and non-medical services", "A2 having knowledge to answer patients questions", "A3 employees are polite", and "E1 given individual attention to patients" for development and improvement.

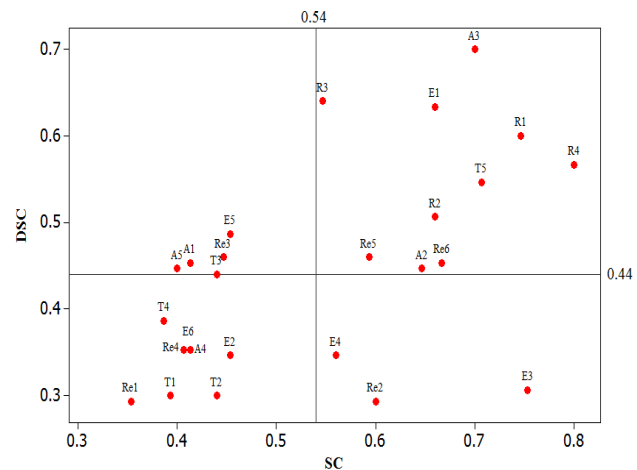Fig. 2 Customer satisfaction matrix

VI. Conclusion

This study attempts to apply a Kano two-dimensional quality model to classify possible clinical laboratory attributes and adopt the customer satisfaction coefficient to quantitatively evaluate the satisfaction and preferences of these strategies from professional designers and customers.

The results of the Kano model and customer satisfaction matrix indicate that ten service quality attributes have a priority to take into consideration which means that offering these services can create higher levels of customer satisfaction. So, BMC should focus these attributes which have the greatest effect on customer satisfaction.

This is the first step towards a successful implementation of these attributes by learning about market demands and customer's acceptability. The experimental result further proves that the proposed approach could be a useful tool to

support design communication for decreasing the gap between designers and customers.

Lessons with respect to clinical laboratory issues learned from investigating experiences in Libya might be also referable to other organizations that are facing similar research requirements and problems. Continuous updates of these dimensions and attributes development from the proposed approach to be an efficient decision support tool could be a future focus for further research.

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