Classifying Software Requirements Using Kano's Model to Optimize Customer Satisfaction

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Abstract. Requirements elicitation is a critical and error-prone stage in software development where user requirements should be defined accurately to ensure the success of the software system. In a highly competitive market, businesses are focusing more on satisfying customer needs which largely affect customers decision to buy the software product, providing the potential for the success of the software in the market. This study aims to investigate whether eliciting and thus fulfilling most of the individual software requirements imply a high level of customer satisfaction, and what type of requirements that define the perceived product quality and as a result customer satisfaction. To achieve this goal, a questionnaire is conducted based on Kano's model for customer satisfaction in an academic environment. The results showed the priorities that should be followed in the implementation of user requirements which may lead to a higher customer satisfaction and as a consequence to the success of the software.

Keywords. Requirements elicitation, Customer satisfaction, Quality requirements, Kano's model, Questionnaire

1. Introduction

To deliver a successful software product, developers need to develop, document, and validate software requirements. When requirements are properly understood, they become the basis for determining the success of the implemented software. In a highly competitive global market, the successful software development is becoming more challenging, because businesses now are looking for ways to shorten the development time to release their products to the market in less time [1]. In addition, businesses are focusing more on satisfying customer needs which largely affect customers decision to buy the product. Therefore, identifying customer needs and transferring them to product design is essential for any business to stay competitive in the market [2] [3]. After all, the purpose of software development is to satisfy users' expectation's, which are precisely what the requirements define.

As Ross and Schoman stated in their paper [4], *"requirements definition must say why a system is needed, based on current or foreseen conditions, which may be internal operations or an external market. It must say what* system *features will serve and satisfy this context"*.

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Research in this area [5] [6] pointed out that the process of requirements elicitation is one of the critical activities in the Requirements Engineering process and highly error prone stage in system development. Eliciting, analyzing, and identifying the right requirements is considered a vital but difficult part of software development projects as quoted from Karl Wiegers "*If you don't get the requirements right, it doesn't matter how well you do anything else.*" [7], this indicates that the price for not defining requirements well is high. Poor execution of elicitation almost results in different errors caused by incorrect, incomplete, missing, or conflicting requirements. Defective requirements may result in expensive rework, poor quality, cost overrun, schedule overrun and dissatisfaction of customer [5]. Thus, if developers identify the defective requirements early during the requirements elicitation process, they can dramatically reduce the cost of emendation of these errors in the software product.

The aim of this study is to investigate whether eliciting and thus fulfilling most of the software requirements imply a high level of customer satisfaction, and what type of requirements that define the perceived product quality and as a result customer satisfaction?

The paper presents an empirical research using a customer survey conducted in an academic environment in one of the universities in Malaysia.

The paper is organized as follows, Section2 reviews the concept of customer satisfaction in the literature, Section3 presents Kano's Model of customer satisfaction, Section4 presents the questionnaire, Section5 discusses the results of the questionnaire, and finally a discussion and conclusion are presented in Section6.

2. Customer Satisfaction in the Literature

The construct "customer satisfaction" is very popular in business environment. Studies about customer satisfaction defined it as an evaluation between what was received and what was expected [8] [9], '*emphasizing the perceptual, evaluative and psychological processes that contribute to customer satisfaction*' [10]. Several research works found direct effect of perceived performance on the level of satisfaction associated with performance that fulfills expectations, while dissatisfaction happens when performance falls below expectations [11]. However, other researchers argued that customers may feel satisfied by aspects they never expect them before [12]. The Value- Percept theory explains satisfaction as an emotional response caused by cognitive-evaluative process [13]. They discussed it as a comparison between the product or service and human values (needs and wants) rather than expectations, whereas other researchers contended that satisfaction should be viewed as a cumulative experience made with a certain product or service [14].

In general, there is a consensus that satisfaction is the feeling of pleasure or on the other hand disappointment, a person may feel when comparing the product's performance with the person's expectations, where customers shape their expectations from past purchases, Friend's advice, and announcements [15].

In the literature of operation management, it views customers as playing vital role in the business process of any organization. When decision makers starts to construct strategies, they first consider the customer of the organization [16]. When making strategic planning they need to know who will need to consume the product, where

customers are located, for how much can they buy, and will it yield them maximum satisfaction? Based on the information gathered, the organization starts the design of the product and explores the market. This shows the importance of satisfying customers in the business environment. To become competitive in today's market, companies need to deliver superior value to the target customers and develop higher quality products and services, since it is found that *"quality has a direct impact on product performance, and thus on customer satisfaction"* [17].

3. KANOs' Model of Customer Satisfaction

Customer needs have increasingly become the focus of software enterprises in a highly competitive market. Hence, understanding and satisfying customers' needs play a vital role in software business success. Capturing the right requirements of customers and users depends substantially on how well getting them involved in system development. Several studies [18] [19] have found that understanding the needs of users and how they operate in the context of the proposed software and in the wider context of the organizational system where the product will be installed can help identify requirements with increased accuracy and completeness and increase customer satisfaction providing more potential for the success of the software product.

In the 1980's Professor Noriaki Kano [20] proposed the model known as "Kano's model" for product quality measurement, the model represents the relationship between customer satisfaction and quality requirements and classifies customer preferences into different categories which impact customer satisfaction with the product in different ways. This model can be applied to measure the degree of satisfaction with the software product as it explains how customer satisfaction would change when requirements are met by the developer. As shown in Figure 1 and explained by different studies [13] [15] [21], the quality requirements are represented as:
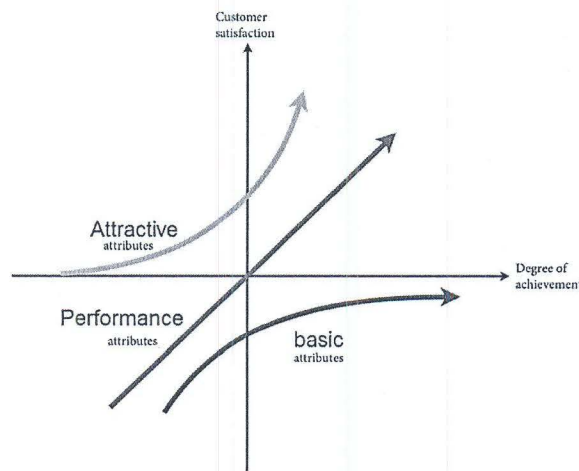

Figure 1. Kano model of user satisfaction

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- **The One Dimension quality (Performance)** line depicts a direct correlation between customer satisfaction and the degree of implementing certain requirements in the product i.e. if those quality requirements met, customer satisfaction will increase and if missed will make him/her dissatisfied. Customers explicitly state these requirements because they expect them to be in the product e.g. the amount of free storage space in Hotmail. Usually companies tend to compete on these attributes to differentiate their product than others, so they may spend more (or less) than their competitors on certain performance attributes or requirements.
- **The Basic quality (Must be)** attributes are those assumed by customer to be in the product, therefore, not explicitly stated as they are taken for granted. As in Figure 1, the entire basic quality line is in the dissatisfaction region, this means when basic quality attributes achieved it will not add to the customer satisfaction level as he/she assumes to find them there, however, if they left out it will make the customer very dissatisfied because they are deemed very necessary. For example, a web application like Hotmail, it should be that it's always available.
- **The Excitement quality (Attractive)** attributes are unexpected items for the customers; they represent the innovation of the developer. Customers may not know or think of them before, but they like them when provided in the product. Figure 1 shows the entire excited quality line in the satisfaction region, which means that when customer is faced with an exciting attribute it may affect their decision to buy the product. As an example, for Gmail it might be Priority Inbox that intelligently label and sort user unread mail.

4. The questionnaire

4.1.1 Background

Most of the students of University Malaysia Pahang (UMP) are frequently take the bus as a mean of transportation from and to the university. They usually buy tickets from bus counters in the terminal located in the city. Currently, staff at the bus ticket counter is using an internal system to sell ticket at the counter and customer has to go to the counter to buy the ticket. Many times, customer needs to queue up to buy the ticket and ask for information. So, the idea of the 'Online Bus Ticketing Software' arouse to serve the university students.

Based on *Kano's model,* a questionnaire is designed and implemented in an academic environment in the University of Pahang in Malaysia to elicit customer preferred functions and classify them into categories as stated in Kano's model, in an attempt to figure out features that are likely increase customer satisfaction with the proposed software.

4.1.2 Design

Before starting the design and in an attempt to identify customer functional requirements, several short interviews have been conducted with randomly selected students in the university. Two questions were used to assist in collecting information about the customer needs and expectations and to investigate the problems they encounter in purchasing bus tickets [21]. These questions are:

Q1. Which criteria does the customer take into consideration when buying the bus ticket?

Q2. Which new features would better meet the expectations of the customer?

Based on the information collected from the students, 19 requirements have been identified as possible needs and expectations of students about what the system may provide.

According to Kano [20], a pair of questions is constructed for every requirement, where the respondents can answer each question in one of five different ways (See Figure 2).

Functional form of the question

How do you feel, if the system provides *bus scheduling* feature of every bus company for the customer?	1. I like it that way 2. It must be that way 3. I am neutral 4. I can live with it that way 5. I dislike it that way
How do you feel, if the system does not provide *bus scheduling* feature of every bus company for the customer?	1. I like it that way 2. It must be that way 3. I am neutral 4. I can live with it that way 5. I dislike it that way

Dysfunctional form of the question

Figure 2. Functional and Dysfunctional questions in Kano's questionnaire

The first question concerns how the customer feels if the software provides that feature (functional form of the question), the second concerns how the customer feels if the software does not provide that feature (dysfunctional form of the question). The questions should demonstrate only 'What' feature the customer wants because customer is not usually interested in how this feature will be implemented. In addition, if the question contains any solution to the customer problem, this will eliminate the creativity of the designer in later stage [21]. The customer response expresses which the real value is for the customer. As illustrated in Figure 10 in the study of [22] which represents Kano's evaluation matrix, the answers of the two questions (Functional and

Dysfunctional) are combined to categorize every requirement based on the customer responses. For example, if the answer for a Functional question for a requirement is "I like it that way", and the answer for a Dysfunctional question for the same requirement is " it must be that way" or "I am neutral" or "I can live with it that way, the combination of the questions in the evaluation matrix produces category (A) indicating that this requirement is an attractive requirement from the customer's viewpoint. Likewise, if the answer to a Functional question for a requirement is "I like it that way", and the answer for a Dysfunctional question for the same requirement is "I dislike it that way", the combination of the questions in the evaluation matrix produces category (O) indicating that this requirement is regarded as one dimensional requirement from the customer's viewpoint. While, if the answer to a Functional question is "I am neutral" or "I can live with it that way" or "it must be that way" and the answer for a Dysfunctional question is "I dislike it that way" the combination of the questions in the evaluation matrix produces category (M) indicating that this requirement is a basic requirement from the customer's viewpoint. In addition to the three categories in Kano's model which are on dimension (O), Must be (M), and Attractive (A), there are other 3 categories which are used for further analysis of the respondents' answers [22]. These categories are (I) 'indifferent' which means customer does not care whether the feature is provided or not, (Q) 'questionable' which means customer has no idea about it or does not understand it, and (R) 'reverse' which means the customer does not want the feature and they strongly expect the reverse.

4.1.3 Participants

In this study, 63 students from the Faculty of Computer Systems and Software Engineering in University Malaysia Pahang have responded to the questionnaire, they were selected because they are expected to be the customers of the system. All are degree students currently buying their bus tickets from a ticket shops in the city. The questionnaire is distributed to the students in a class room and the researcher had around 10 minutes briefing to introduce the purpose of the questionnaire and explain the correct way to answer the questions before they start. Students have taken around 20 minutes to answer all questions and then sheets were collected from them. No information about names or gender has been requested from the students.

5. Analysis of Data

Data has been collected from the response of every participant to the functional and dysfunctional questions and evaluated based on Kano's evaluation matrix [22]. Six categories of requirements obtained, (M) Must-be, (O) one dimension, (A) attractive, (I) indifferent, (Q) questionable, and (R) reverse. The next step was determining the category of the evaluated software requirements according to the answer frequency; the final results obtained were four categories which are M, A, O, and I. Results are recorded and depicted in Table 1.

Question	Assessed Requirements	A	O	M	I	R	Q	Total	Category
1	Member Registration	19	22	1	16	5	0	63	O
2	Member Login	7	23	11	20	2	0	63	O
3	User Polling	22	10	3	25	3	0	63	I
4	View Company's Bus Information	17	20	21	5	0	0	63	M
5	Check Seat Availability	13	19	24	7	0	0	63	M
6	Check Bus Schedule	8	19	21	15	0	0	63	M
7	See fare list	8	18	20	15	1	1	63	M
8	Select Seat (window / Non-window)	25	16	6	16	0	0	63	A
9	Select Seat (Single seat line / Double seat line)	21	17	6	19	0	0	63	A
10	Cancel Booking	13	16	19	12	2	1	63	M
11	Print Ticket	6	17	20	16	2	2	63	M
12	Send Feedback	12	9	5	33	3	1	63	I
13	View and Send Forum	13	7	5	35	3	0	63	I
14	Choose Number of Passenger	15	18	12	17	0	1	63	O
15	Choose Number of Children	17	20	7	18	1	0	63	I
16	Sending SMS of change for customer.	21	20	9	13	0	0	63	A
17	Distinguishes between "Rush /Normal time"	32	9	3	18	1	0	63	A
18	Display confirmation of reservation	12	18	22	11	0	0	63	M
19	Payment method	16	10	24	11	2	0	63	M

Table 1. Summary of questionnaire results

6. Discussion and conclusion

The results in Table 1 shows that some requirements are classified as attractive, such as the requirement concerns the selection of seat " Select Seat (window / Non-window)" , " Select Seat (Single seat line / Double seat line)", may be because students are interested with the location of seats and want to get a comfortable place in the bus. Also, informing the passenger about any change by SMS would prevent them from wasting time and effort in case the trip is cancelled or schedule is changed, so they would be more satisfied if they have been informed about the change. Another requirement regarded by the students as attractive is when the system is able to differentiate between rush time and normal time when making reservation for trip and offer different rates for them which may save some money for the students if considered. These requirements are of type (Attractive) in Kano's model and customer would be delighted to find them in the software product.

Other requirements such as " Company's Bus Information", " Checking Seat Availability ", "Bus Scheduling "," Fare Details ", "Cancel booking ", "Printing the

ticket", " Display confirmation message to the customer ", and " Provide different type of payment method for purchasing ticket " are classified as a Must-be requirements by the respondents, which means that they regard them as basic features and would be very dissatisfied with the system if they are missed. So, they must be provided in the software product.

Other requirements are classified as one- dimensional like "Customer registration form", "login", and "choose number of passengers", which demonstrate the desire of respondents to have a secure membership account and to enjoy the discount provided by the bus companies. So, including these features will increase customer satisfaction. While the requirements "user polling", "view feedback", " view and send forum", "choose number of children" are classified as indifferent requirements which means respondents (students) have less interest in them and do not care if they are not provided, especially the feature of the ability to choose number of children with less fare ticket, may be because the respondents are students and almost all of them do not have children yet.

As reported by Sauerwein et al [21] when making decisions during the development about which features to provide, the rule of (must be > one dimensional > attractive > indifferent) should be followed to set priorities. Kanos' model can help customers to express the desired attributes of the product accurately as customers usually find difficulty to state what they want exactly.

The purpose of this study was to investigate whether eliciting and thus fulfilling most of the software requirements imply a high level of customer satisfaction. The final results are based on the classification of the software requirements obtained from the sample that is assumed to be potential customers of the system. The basic requirements (M) are considered crucial to the success of the software and if they are not fulfilled it will lead to a customer being dissatisfied to a large extent that he will try to find another vendor. Therefore, developers should focus on delivering them. Then developers should include the one dimensional requirements (O) as customer satisfaction will increase with the extent to which they are performed. Lastly, and the more important is to invest in improving the exciting requirements (A) as they form the customer incentive to buy the software. To stay competitive in the market, developers need to focus their efforts on these requirements and make sure to constantly develop new ones. Sometimes, developers may need to perform cost analysis to estimate how much this attribute will cost the customer and whether customer will be able to pay for it.

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