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Capturing Customer Satisfaction and Dissatisfaction in Software Requirements Elicitation for Features in Proposed Software Systems

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Abstract: In this study, an attempt was made to capture the satisfaction and dissatisfaction of potential customers of a proposed software system for features of the would be product at the requirements elicitation stage of the development lifecycle. The functional and dysfunctional technique of Kano Model was used. Berger customer satisfaction coefficients were also used for the computation of customer satisfaction and dissatisfaction. The study was conducted at Universiti Utara Malaysia using 50 study participants via. a voice of customer survey. The result reveals that two antecedents or features performed the most in impacting the satisfaction and dissatisfaction of potential customers of the proposed software system. Attractive sand one-dimensional quality elements (or features) had the greatest effect on customer satisfaction and dissatisfaction. This result will aid requirements engineers, developers, designers, projects and sales managers in planning for would be software products. Further, analysis indicated that the satisfaction and dissatisfaction indexes of the Kano Model were highly correlated with the average satisfaction coefficient of Park (r = 96%). This implies that these variables can be used in place of one another or used interchangeably to capture customer satisfaction. Also, satisfaction and dissatisfaction indexes and average satisfaction coefficient are all linearly associated.

Key words: Customer satisfaction and dissatisfaction, requirements elicitation, software features, proposed systems, potential, Malaysia

INTRODUCTION

The field of customer satisfaction has been widely researched on by a broad spectrum of scholars from diverse disciplinary divide. Satisfaction can be seen as a global affective response toward offering consumption or usage that is a global evaluative judgment about product consumption or usage (Westbrook, 1987). Different antecedents to satisfaction and dissatisfaction have been identified by several researchers from fields such as human resources, marketing and engineering. There is however some underlying differences in these antecedents. Some of these antecedents increase satisfaction when present but do not increase dissatisfaction when absent, some increase dissatisfaction when absent but do not increase satisfaction when present, some affect both satisfaction and dissatisfaction and negative assessments to the degree that they are present or absent and lastly, some have no effect on satisfaction and dissatisfaction. Cadotte and Turgeon (1988) and Vargo *et al.* (2007) broadly categorized these factors as: satisfiers, dissatisfiers, criticals and neutrals. On one hand, satisfiers are factors that meet the intrinsic needs of users and customers. These factors are seen as ends in themselves. On the other hand, dissatisfiers are factors that tend to meet the extrinsic needs of users and customers and the minimal requirements of these users and customers. These factors are associated with the functional performance of what the products offers and are also means to ends (Vargo *et al*., 2007). Furthermore, Levitt (1986) in his total product model posits that an evolution exist among the antecedents of satisfaction and dissatisfaction. It is observed that product features that were once satisfiers became critical then eventually became dissatisfiers over time (Cadotte and Turgeon, 1988; Brandt, 1988; Kano *et al*., 1984). Customer satisfaction can be used for competitive advantage. Since, dissatisfiers hinders satisfaction and have greater impact on customer satisfaction or dissatisfaction they must be controlled always in products (Vargo *et al*., 2007). Such customers remain customers for a longer time and offer favorable

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word-of-the-mouth promotion on the product, increase their product purchasing and help enhance the sales of products (Mkpojiogu and Hashim, 2016; Hussain *et al*., 2016a, b). These lead to higher marketability and firm's profitability, sustainability and viability (Mkpojiogu and Hashim, 2016c-e). However, dissatisfied customers are more likely to cease product purchasing, to offer unfavorable word-of-mouth advertising and even, complain, return and completely boycott the product, its brand and even the company or their sales representatives (Vargo *et al*., 2007; Hussain and Mkpojiogu, 2016a, b).

Theoretical approaches to the concepts of satisfaction and dissatisfaction: Most researchers on customer satisfaction base their research on Disconfirmation of Expectation (DE) model. However, this model does not account for the multi-dimensional natures of the antecedents that lead to satisfaction: satisfiers, dissatisfiers, criticals and neutrals. Vargo *et al.* (2007) suggest that further extensions should be made to the DE model or an alternative model be provided. The need gratification model (Oliver, 1997) was developed as an extension to the DE model. In addition, also as an extension to DE model, a context-specific satisfaction framework was developed (Giese and Cote, 2000). The Social Judgment-Involvement (SJI) theory that conceptualizes attitudes as evaluative reference scales comprises of three latitudes, namely: latitude of acceptance, latitude of rejection and latitude of non-commitment. The asymmetric nature of these latitudes is in tandem with the nature of satisfiers and dissatisfiers as captured by Kano *et al.* (1984), Cadotte and Turgeon (1988), Oliver (1997). While satisfiers can be aligned with evaluative reference scales dominated by the latitude of acceptance; dissatisfiers are aligned with evaluative reference scales dominated by the latitude of rejection. Neutrals could be seen in terms of evaluative reference scales dominated by the latitude of non-commitment (Vargo *et al*., 2007). Furthermore, techniques of measurement related to SJI could offer a better measurement of satisfiers and dissatisfiers (Vargo and Lusch, 2005).

Taxonomies and classification of the antecedents to customer satisfaction and dissatisfaction: The following are the taxonomies of the antecedents to satisfaction and dissatisfaction.

Motivator and hygienes: These taxonomies were found in the researches by Herzberg *et al.* (1959). They introduced the two factor theory otherwise known as the motivator-hygiene model. They used the critical incident technique in the context of job satisfaction to evaluate the impact of motivator and hygiene factors on satisfaction and dissatisfaction. Motivators are factors that cause individual satisfaction and sustain motivation for continuous improvement. They are job content factors. On the other hand, hygienes are factors that are unrelated to the job itself but to the conditions associated with the job. They are job-context factors (Vargo *et al*., 2007).

Expressive and instrumental factors: An additional support for Herzberg *et al.* (1959) motivator-hygiene model was reported by Swan and Combs (1976). They associated motivators and hygienes with expressive and instrumental factors, respectively. Expressive factors are the psychological aspects of a product which are ends in themselves. Instrumental factors are physical aspects of a product which are means to a set of ends. However, the presence of criticals is implied to be related to both expressive and instrumental factors (Vargo *et al*., 2007) (Table 1).

Attractive, must-be, one-dimensional and indifferent quality elements: In the field of mechanical engineering, Kano *et al.* (1984) proposed a model that springs from Herzberg *et al.* (1959) motivator-hygiene model. They identified five factors as antecedents to satisfaction and dissatisfaction, inter alia: attractive, must-be, one-dimensional, indifferent and inverse quality elements (or product features). Attractive quality elements (or product features) are factors that increase customer satisfaction when fulfilled (present). They are acceptable even when they are not fulfilled (when they are absent). Must-be elements (or features) are factors that are taken for granted when they are fulfilled (present) but they result in dissatisfaction when they are not fulfilled (absent). One-dimensional elements (features) are factors that cause satisfaction when they are fulfilled (present) and also result in dissatisfaction when they are not fulfilled (absent). Indifferent quality elements (or product features) are the factors that result in neither satisfaction nor dissatisfaction whether they are fulfilled (present) or not. Reverse quality elements (or product features) are the factors that result in satisfaction when not fulfilled (absent) and in dissatisfaction when fulfilled (present) (Hussain and Mkpojiogu, 2015, 2016a, b; Hussain *et al*., 2016a-e; Mkpojiogu and Hashim, 2015). These factors mirror one-dimensional quality elements (Vargo *et al*., 2007).

Table 1: Taxonomies of antecedents to satisfaction and dissatisfaction

	Antecedents to satisfaction and dissatisfaction			
Sources	1	2	3	4
Herzberg *et al.* (1959), Soliman (1970), Zhang and Dran (2000)	Motivators	Hygienes	-	-
Swan and Combs (1976)	Expressive factors	Instrumental factors	-	-
Kano *et al.* (1984), Berger *et al.* (1993), Matzler and Hinterhuber (1998)	Attractive	Must-be	One-dimensional	Indifferent
Oliver (1997)	Monovalent satisfiers	Monovalent dissatisfiers	Bivalent satisfiers	Null relationships
Cadotte and Turgeon (1988)	Satisfiers	Dissatisfiers	Criticals	Neutrals
Vargo *et al.* (2007)				

Monovalent dissatisfiers, monovalent satisfiers, bivalent satisfiers and null relationships: Oliver (1997) conceptualized the relationship between need fulfillment and satisfaction in terms of monovalent dissatisfiers, monovalent satisfiers and bivalent satisfiers. Monovalent dissatisfiers "dissatisfiers" provide the highest source of dissatisfaction. Monovalent satisfiers "satisfiers" provide the highest source of satisfaction while bivalent satisfiers "criticals" impact both satisfaction and dissatisfaction. While the degree of bivalent satisfiers influences satisfaction linearly, the decrease in the degree of monovalent satisfiers does not lead to dissatisfaction and the increase in the degree of monovalent dissatisfiers does not result in satisfaction. Oliver (1997) stressed that the line of distinction between satisfaction and dissatisfaction may not be clear but it may be seen as a zone as a zone of indifference. He maintained that monovalent satisfiers and dissatisfiers make modest contribution to satisfaction and dissatisfaction.

Satisfiers, dissatisfiers, criticals and neutrals: Cadotte and Turgeon (1988), satisfiers, dissatisfiers, criticals and neutrals are represented as hypothetical distribution of perceived performance. The relative placement and dominance (with regard to positive and negative evaluations) of a zone of indifference, representing neutral evaluations is the distinctive feature of these distributions (Vargo *et al.*, 2007). Satisfiers are factors that elicit satisfaction when present but their absence does not lead to dissatisfaction (Cadotte and Turgeon, 1988). They meet the intrinsic needs of customers. Dissatisfiers are factors in which low performance (or the absence of a feature) can lead to dissatisfaction, however higher levels of performance of the attribute (that is the presence of the feature) do not enhance satisfaction. These factors meet the extrinsic needs of customers. Extrinsic needs are functional and instrumental toward an end (Vargo *et al.*, 2007). Criticals are factors that elicit both positive and negative feelings (Cadotte and Turgeon, 1988). These factors may perhaps be the most significant factors to control since they create a positive or negative effect on satisfaction and dissatisfaction. Criticals tend to be the core or the generic aspects of a product. Neutrals are factors that do not produce positive or negative evaluations irrespective of whether they are present or absent (Vargo *et al.*, 2007; Cadotte and Turgeon, 1988).

Dissatisfiers seem to have a greater effect on consumer satisfaction or dissatisfaction, however the effect of criticals on customer satisfaction or dissatisfaction, seems to be more than that of both satisfiers and dissatisfiers because criticals presents core or generic offerings of a product (Levitt, 1986). Over time, satisfiers evolve and become criticals and then eventually become dissatisfiers using Kano *et al.* (1984) terminology: from attractive, to must-be and then to one-dimensional quality elements) due to competition, advancement in technology, changes in the needs and expectations of customers. The cycle of evolution from satisfiers to critical to dissatisfiers may also arise when a customer's relationship with the company changes. This implies that new customers might see certain factors as satisfiers while loyal (old) customers may see these factors as expected factors and thus, the factors become dissatisfiers. On the long run, success in the promotion of a product depends not only on successfully meeting customer's expectations or even exceeding it but also on the monitoring of these expectations by the product and sales managers (Vargo *et al.*, 2007).

Methodological approaches to the evaluation of customer satisfaction and dissatisfaction: Some methodological approaches have been utilized in assessing the antecedents of satisfaction and dissatisfaction. These approaches include: the critical incidence technique, functional and dysfunctional technique and the need-gratification technique. The critical incident technique used by Herzberg *et al.* (1959), Cadotte and Turgeon (1988) requires that respondents will identify the incidents (service-encounter related or work related) which made them exceptionally satisfied or dissatisfied. Next, the incidents are categorized via a two-by-two matrix of high and low satisfaction and dissatisfaction (or associated attitudes like compliments and complaints). The incidents responsible for only satisfaction are captured as satisfiers while those that are

responsible for only dissatisfaction are captured as dissatisfiers (Vargo *et al*., 2007). In addition, the functional and dysfunctional technique has been applied by Kano *et al*. (1984), Berger *et al*. (1993), Matzler and Hinterhuber (1998). This technique requires that customers categorize their responses to both functional (that is presence of or high level) and dysfunctional (that is absence of or low level) states of a product attribute (or feature) as any (one) of the following options: I like it that way, it must-be that way, I am neutral, I can live with it that way and I dislike it (Vargo *et al*., 2007; Hussain and Mkpojiogu, 2016a, b; Hussain *et al*., 2015, 2016a-e; Mkpojiogu and Hashim, 2015; Hussain and Mkpojiogu, 2016a, b). Furthermore, the need gratification technique proposed by Oliver (1997) requires respondents to answer whether performance on a product attribute (feature) met, fell short or exceeded their needs on a provided need-gratification scale. With this, each product attribute (feature) are assessed by looking at the association between responses on the need-gratification scale and the overall satisfaction. More so, he argues that the observed relationships should show a curvilinear trend for monovalent dissatisfiers and monovalent satisfiers. However, Oliver (1997) posits that some (that is bivalent satisfiers/criticals) will display a monotonically increasing associations. He argued that relationship that is "null" or random reveals that need-fulfillment is not associated with satisfaction (Vargo *et al*., 2007).

Requirements elicitation: Requirements elicitation is the process of capturing and determining customer's requirements/product features for a system to be built that results in high probability of satisfying the stakeholders and end-user's needs (Kumari and Pillai, 2013). Requirements elicitation involves the convergence of the mental model of stakeholders; this convergence poses a great challenge to the requirements elicitation process (Dyba and Cruzes, 2013). Sharma and Pandey (2014) categorized elicitation methods into the following: conversational, collaborative; contextual (observational) and cognitive methods. The traditional elicitation methods include: interviews, surveys, background reading document analysis, workshop, focus group, brainstorming (Mohanani *et al*., 2014). There are many collaborative methods identified, among them are: cooperative requirements capture, joint application design, quality function deployment; these techniques foster communication between the stakeholders and the analysts and facilitate group collaboration (Lai *et al*., 2014). Some methods are a combination of collaboration and communication methods like group storytelling, narrative network modeling and dialogue game. Furthermore, these requirements when captured are further represented or encapsulated in a requirements model (Jang *et al*., 2012) for better communication. The above itemized methods are good but are limitedin probing the mind of the user/customer and they are not explicitly designed to capturethe satisfactionor dissatisfaction customers or users will have from the meeting or not meeting of requirements with the aim of enhancing the quality of the intended product.

MATERIALS AND METHODS

The approach used in this study was based on the Kano *et al*. (1984)'s Model. The functional and dysfunctional technique of Kano Model was utilized. Kano Model is used as it allows for user satisfying requirements to be elicited and categorized based on quality attributes. The Kano Model was designed to provide qualitative categorization of requirements and attributes of intended products and thus was limited for quantitative evaluation. As a result of this, Berger *et al*. (1993) improved on the model by providing the coefficient of Customer Satisfaction (CS). These coefficients capture customer Satisfaction (SI) and Dissatisfaction (DI) as shown in Eq. 1 and 2:

$$SI = \frac{A+0}{A+O+M+I} \quad (1)$$

$$DI = \frac{O+M}{A+O+M+I} \quad (2)$$

From the above equations, SI is the degree of satisfaction obtained when the features are present in the product; DI is the degree of dissatisfaction felt when the features are absent in the product. SI and DI also indicate the influence of the placement of the features on such product. They capture the importance value of quality attributes (features). A is Attractive feature, O is one-dimensional feature, M is must-be feature and I is indifferent feature. The minus sign placed in the DI equation emphasizes the negative influence of the feature/attribute on customer's satisfaction. The coefficient ranges from 0-1. A positive CS-coefficient runs from 0-1 while a negative CS-coefficient ranges from 0-1. Zero implies no influence on satisfaction if the feature is met (as in SI) or on dissatisfaction if the feature is not met (as in DI). The closer the value is to 1, the greater the impact of meeting the feature is on user/customer satisfaction (that is for SI) and the closer the value is to -1, the greater the influence of not placing the feature on the product is on customer dissatisfaction (that is for

DI). The closer the value is to zero, the lesser the influence (Kano *et al*., 1984; Matzler and Hinterhuber, 1998; Zhu *et al*., 2010; Berger *et al*., 1993) implying that the feature has lesser impact oncustomer satisfaction and on perceived software product quality.

Jang *et al*. (2012) proposed the Average Satisfaction Coefficient (ASC) as shown in Eq. 3 below to determine the importance value of quality attributes (features). They showed that SI and DI can be averaged to obtain an average satisfaction coefficient another measure of the degree of satisfaction customers derive from met features. The measure captures the perceived quality of would-be products features and the influence of features on such products:

$$ASC = \frac{(SI + DI)}{2} \quad (3)$$

In this study, Kano Model was used for data collection and analysis as well as in the categorization of requirements/features. Berger *et al*. (1993) extension of Kano Model (Kano *et al*., 1984) was applied in capturingcustomer satisfaction and dissatisfaction. A Kano questionnaire was constructed and administered to a fifty respondents during the Kano survey and survey ethics were dulyob served. The participants were staffand students of Universiti Utara Malaysia, Malaysia. All participants are potential users of the proposed e-Ebola awareness system and all had pre-knowledge of the ebola virus disease. With the sample size of fifty the expected margin of error will be 13%. During the administration, a screening question was asked to screen out those who are not eligible to respond to the questionnaire. The screening question was: “have you heard of Ebola in the past?”. Only respondents that responded “Yes” were eligible to respond to the Kano questions.

After the survey, the responses were collated andanalyzed using a semi-automated Kano analysis excel tool. Further analysis was done with SPSS Version 17 package. In addition, the requirements/features were categorized following Kano’s approach (Kano *et al*., 1984) and the coefficient of user/customer satisfaction was computed using Berger *et al*. (1993) method. The entire survey instrument was checked and assessed for reliability using Cronbach’s alpha and the result was 0.79 indicating a good internal consistency of the questionnaire items. The Cronbach’s alpha coefficient is usually used in computing the reliability of a survey instrument. A Cronbach’s alpha of 0.7 and above is usually accepted as an acceptable reliability coefficient (Nunnaly, 1978). Furthermore, five features/requirements were elicited and evaluated in this study. They include: F1: locally generated content on ebola F2: ebola Tweets from Twitter; F3: ebola news via google news; F4: content translation through google translate; F5: security of content. These five features are the main features expected to be incorporated in the design of the first release of the proposed software product.

RESULTS AND DISCUSSION

In this study five features were elicited. From the Kano analysis shown in Table 2 of the five features, only one is an attractive feature, the remaining four are one-dimensional features. The attractive feature implies that it increases customer satisfaction when present in the product. In addition, the one-dimensional features imply that they lead to satisfaction when they are present in the proposed product and also result in dissatisfaction when they are absent. Table 2 also displays the satisfaction and dissatisfaction indexes of each elicited feature. Feature F4 has the highest satisfaction index (0.72) (also indicating that it is the most important feature) followed by feature FI (0.64). Feature F5 has the least satisfaction index (0.52) (also indicating that it is the least important feature). This result is corroborated by the average satisfaction coefficients. On the other hand, features F3 and F4 have the highest dissatisfaction index (-0.62) while feature F2 has the lowest dissatisfaction index (-0.43). In this study, attractive and one-dimensional factors have the greatest impact on the satisfaction and dissatisfaction of potential customers of the proposed product. These two antecedents performed better than others in influencing customer satisfaction and dissatisfaction.

Table 3 provides the two tail Pearson r, correlation analysis for SI, DI and ASC variables. SI and ASC ($r = 0.96$) are significantly associated, $p<0.05$. Also, DI and ASC ($r = 0.96$) are significantly associated at $p<0.01$. However, SI and DI are not significantly associated in a two tail relationship. Also, Table 4 corroborated with Table 1 and further explains the relationship between SI, DI and ASC in a one-tail Pearson (r) relationship. SI and ASC ($r = 0.96$) and DI and ASC ($r = 0.96$) are also significantly correlated, $p<0.01$. However, unlike the result in Table 1 (two-tail relationship) there is a significant one-tail association between SI and DI ($r = 0.84$) at $p<0.05$. As can be observed, there is a very high association between SI and ASC and DI and ASC (both have $r = 0.96$). This implies that ASC is similar to SI and DI and can be used interchangeably (that is ASC can be used in place of either SI or DI and vice-versa to represent customer

Table 2: Kano attribute/feature categorization and customer satisfaction/dissatisfaction coefficients

Features	M (%)	O (%)	A (%)	I (%)	R (%)	Q (%)	Total (%)	Category	SI	Di	ASC
F1	22	28	32	12	06	-	100	A	0.64	-0.53	0.59
F2	10	30	26	28	06	-	100	O	0.60	-0.43	0.52
F3	14	44	22	14	04	02	100	O	0.70	-0.62	0.66
F4	14	44	24	12	06	-	100	O	0.72	-0.62	0.67
F5	08	36	12	36	08	-	100	O	0.52	-0.48	0.50

A: Attractive; O: One-dimensional; M: Must-be; I: Indifference; R: Reverse; Q: Questionable; F1-F5: Features (Mkpojiogu and Hashim, 2016)

Table 3: A two-tail pearson (r) correlation analysis for SI, DI and ASC; p-values in (), p<0.01 level**; p<0.05 level*

Variables	SI	DI	ASC
SI	1		
DI	0.836 (0.078)	1	
ASC	0.956 (0.011)*	0.960 (0.010)**	1

Mkpojiogu and Hashim (2016)

Table 4: A one-tail pearson (r) correlation analysis for SI, DI and ASC; p-values in (), p<0.01 level**; p<0.05 level*

Variables	SI	DI	ASC
SI	1		
DI	0.836 (0.039)*	1	
ASC	0.956 (0.006)**	0.960 (0.005)**	1

Mkpojiogu and Hashim (2016)

satisfaction). Also, SI and DI are only correlated in one direction that is, the increase in the satisfaction customers will derive from features that are present in the product is proportional to the dissatisfaction that they will receive if such features are absent. But the reverse is not the case.

CONCLUSION

In this study, an attempt was made to capture the satisfaction and dissatisfaction of potential customers of a proposed software system for features of the would-be product at the requirements elicitation stage of the development lifecycle. The functional and dysfunctional technique by Kano *et al.* (1984) Model was used. Berger *et al.* (1993) customer satisfaction coefficients were also used to capture customer satisfaction and dissatisfaction. The study was conducted in Universiti Utara Malaysia using 50 study participants through a voice of customer survey. The result reveals that two antecedents or features performed the most in influencing the satisfaction and dissatisfaction of potential customers of the proposed software system. Attractive and one-dimensional quality elements (or features) had the greatest effect on customer satisfaction and dissatisfaction. This result will aid requirements engineers, developers, designers, projects and sales managers in planning for would-be software products. Further analysis indicated that the satisfaction and dissatisfaction indexes of the Kano Model are highly correlated with the average satisfaction coefficient by Jang *et al.* (2012) (r = 96%). This implies that these variables can be used in place of one another or used interchangeably to capture customer satisfaction. Further, still, the associations between the three indexes/coefficients (SI, DI and ASC) have a positive linear trend. This study confirms Kano Model as well as its extensions.

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