A GENERALIZATION OF TRADITIONAL KANO MODEL FOR CUSTOMER REQUIREMENTS ANALYSIS

DOI: 10.12776/QIP.V19I1.407

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Received 2 September 2014, Revised 14 September 2014, Accepted 10 May 2015

ABSTRACT

Purpose: The theory of attractiveness determines the relationship between the technically achieved and customer perceived quality of product attributes. The most frequently used approach in the theory of attractiveness is the implementation of Kano‘s model. There exist a lot of generalizations of that model which take into consideration various aspects and approaches focused on understanding the customer preferences and identification of his priorities for a selling product. The aim of this article is to outline another possible generalization of Kano‘s model.

Methodology/Approach: The traditional Kano’s model captures the nonlinear relationship between reached attributes of quality and customer requirements. The individual attributes of quality are divided into three main categories: must-be, one-dimensional, attractive quality and into two side categories: indifferent and reverse quality. The well selling product has to contain the must-be attribute. It should contain as many one-dimensional attributes as possible. If there are also supplementary attractive attributes, it means that attractiveness of the entire product, from the viewpoint of the customer, nonlinearly sharply rises what has a direct positive impact on a decision of potential customer when purchasing the product. In this article, we show that inclusion of individual quality attributes of a product to the mentioned categories depends, among other things, also on costs on life cycle of the product, respectively on a price of the product on the market.

Findings: In practice, we are often encountering the inclusion of products into different price categories: lower, middle and upper class. For a certain type of products the category is either directly declared by a producer (especially in automotive industry), or is determined by a customer by means of assessment of available market prices. To each of those groups of a products different customer expectations can be assigned. In this paper, we investigate how the inclusion of

a product into some price category influences a categorization of its quality attributes in the context of a Kano‘s model.

Research Limitation/implication: The theory of attractiveness has a big sense for developers in designing new products. It is therefore natural to know the real demands of customers and prioritize different quality attributes of a product in terms of customers´perception. Sufficiently precise fulfilment of this requirement is however an open problem so far.

Originality/Value of paper: The article points out certain dynamics in perception of individual attributes of quality by customers relative to inclusion of a product into some price categories. It is therefore a certain generalization of the fundamental principles of traditional Kano’s model.

Keywords: Kano´s model; customer satisfaction; customer requirements

1 INTRODUCTION

The theory of attractiveness determines relationship between the technically achieved and customer perceived quality of product attributes. The most frequently used approach in the theory of attractiveness is the implementation of Kano‘s model. There are many generalizations of that model which take into consideration various aspects and approaches focused on understanding the customer preferences and identification of his priorities for a selling product. The aim of this article is to outline another possible generalization of Kano‘s model.

The traditional Kano’s model captures the nonlinear relationship between reached attributes of quality and customer requirements. The individual attributes of quality are divided into three main categories: must-be, one-dimensional, attractive quality and into two side categories: indifferent and reverse quality. The well selling product has to contain the must-be attribute. It should contain as many one-dimensional attributes as possible. If there are also supplementary attractive attributes, it means that attractiveness of the entire product, from the viewpoint of the customer, nonlinearly sharply rises what has a direct positive impact on a decision of potential customer when purchasing the product. In this article, we show that inclusion of individual quality attributes of a product to the mentioned categories depends, among other things, also on costs on life cycle of the product, respectively on a price of the product on the market.

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The theory of attractiveness is of great importance for developers in designing new products. It is therefore natural to know real demands of customers and prioritize different quality attributes of a product in terms of customers´perception. Sufficiently precise fulfilment of this requirement is however an open problem so far.

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2 KANO'S MODEL

The evaluation of customer requirements acquires increasing importance in the area of marketing. Identifying customer needs became a prime task for companies that compete in the global market (Jahnátek et al., 2008). In practice, it has been shown that customers perceive individual attributes of reached quality differently. That is why in the last years the perceived quality has been the object of considerable interest from both the research workers and managers. Different methods and tools that help companies to better understand requirements of customers were developed. Among them probably the best known is Kano's model. Kano et al. (1984) proposed a two-dimensional model describing the attractive quality of nonlinear relationship between achieved and customer perceived quality concerning individual attributes of a product. Kano's model defines three main and two side categories of perceived quality, described by example (Robinson, 2009; Lajczykova and Zgodavova, 2013):

1) Must-be quality. That first basic category (also known as "expected quality", "basic quality" and "dissatisfiers") describes those attributes, which a customer naturally supposes that the product has, respectively has on a sufficient good level. Otherwise, we can assume that a customer will be very dissatisfied. The presence of these properties in a product is not valued by a customer (low attractiveness). However, if missing, the customer dissatisfaction non-linearly sharply rises. These are the attributes so natural from the a customer´s perspective that they do not appear in the VOC (Voice of Customer) findings.
2) One-dimensional quality. The second category (also known as "output quality", "ordinary needs satisfiers" and "the more the better" properties) concerns those attributes that proportionately increase satisfaction when fulfilled and proportionately decrease~~s~~ customer satisfaction if not sufficiently fulfilled. These are the attributes that the customer perceives, cares about them and talks about them determining the VOC requirements.
3) Attractive quality. It is the most attractive category of quality, also known as "exciting quality" and "delighters". It consists of attributes that surprise and please the customer. They provide a big satisfaction when achieved,

but do not cause dissatisfaction when not fulfilled, since the customer does not expect such a quality attribute of a product. When the VOC is determined, they are non-uttered requirements and a customer gives his opinion on them only when he is prompted. If the attribute is fulfilled, the satisfaction of a customer increases dramatically and nonlinearly. These attributes can lead customers to the immediate purchase or to the prioritization of a product on purchase.

4) Indifferent quality. It is a secondary category, also known as "neutral" and includes such attributes the presence of which does not bring satisfaction, but their absence does not result in dissatisfaction. Customer does not talk about them during the VOC, even though he is prompted to do that because he does not regard them as essential.
5) Reverse quality. It is a secondary category, also known as a property of turn and includes such attributes of a product whose presence or increase of reached quality causes dissatisfaction of a customer. When a level of quality reached is increasing the satisfaction of a customer is descending. These attributes of quality usually point out existence of a different group of customers (separate market segment). For example, there are some customers preferring simplicity of a product. For them the improvement of certain quality attributes is more of a burden than a contribution. If they have a feeling that the improvement is at the expense of other important attributes of a quality, they have a tendency to search products than do not have those properties.

The traditional Kano's model considered a categorisation of individual quality attributes for a given market segment from the view of a customer as static. Some later studies indicate that the classification of quality attributes into individual categories in the sense of the Kano's model is dynamic. It has been shown that the task of quality attributes is changing with time (Kano, 2001) (Figure 1).

The relationship between objective output and a customer satisfaction in different stages of development of a relationship with a customer was described by Mittal and Katrichis (2000). A similar relationship in different stages of development was studied by Johnson et al. (2006).

Löfgren et al. (2011) introduced the empirical proof of existence of some alternative life cycles of individual quality attributes.

This article is focused on the description of a development dynamics of a relationship between objective output and a perceived customer satisfaction of the expected total costs of a product life cycle. In many studies the costs on life cycle of a product or a price of a product are considered as one of the possible attributes of quality while its attractiveness from the viewpoint of customers is researched.

This general attribute of quality often significantly influences the level of customer perceived quality. An attribute that is in the luxury class considered as a must-be attribute can be understand as a one-dimensional attribute in the

middle class and in low cost class that attribute can fulfil all conditions needed for incorporation to the attractive class.

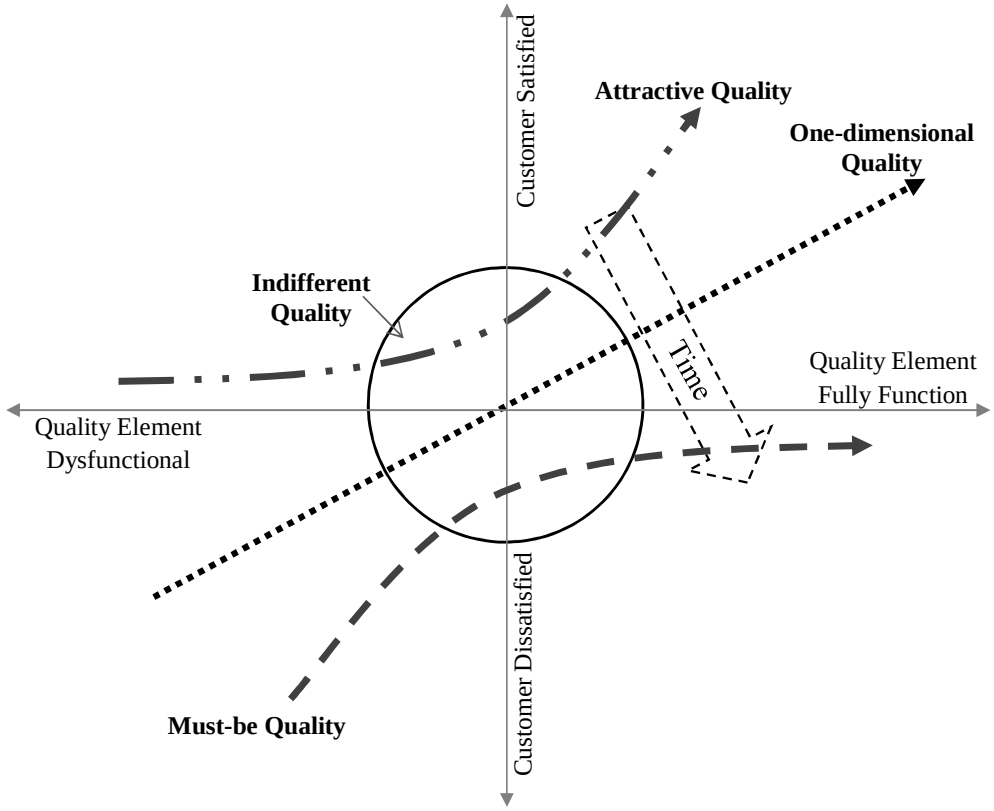

Figure 1 – The analytical Kano model (Lee et al., 2011)

For many customers the ratio price/quality is a significant factor that influences the decision about purchase of a product. In an empirical study described in this article we will define the relation between achieved and perceived quality for individual attributes of product quality from the view of three main price categories and nine price subcategories of a product.

3 METHODOLOGY

In order to develop the DEA models to assess the performance of the Maintenance Departments from multiple perspectives, first, it is necessary to develop a simplified BSC model for the studied company founded in 2003. Since then team of engineers have been gathering experiences from various fields of mechanical engineering. It offers a wide range of road maintenance equipment.

An important factor that influences the decision to buy a product is its life-cycle costs. These are all costs related to use of the purchase product. In case that operational costs of all competitive products on the market are comparable (eg. in

consumer elecronics) then one of the decisive factors in purchase of product is its price. The division of goods and services into price categories is often determined by the producer. For example, in air transport economy and business classes are usual. In car industry, the cars are divided into three classes – low, middle and upper class. There are cases where price of service can be determined only on statistical utilisation (Bober, 2014). Our study is based on the assumption that even if the seller does not classify a product into some category, consumer intuitively makes a classification of a product into one of three categories – low cost, middle, luxury.

A product price estimated by a consumer aims his attention primarily to one of his preferred price categories in which the product was classified by him. It often causes that he is no more interested in other price categories. Such an orientation is often determined by price unavailability of products from higher categories, or by fear of losing certain social prestige when buying a product of a lower category.

In the literature (Xu et al., 2009), particular approach is presented when individual categories are regarded as different market segments. Nevertheless, that would mean that a customer who is decided to buy a product from a middle category is deciding only within the class. However, when buying a product a lot of customers apply a philosophy focused on maximalization of a quality/price ratio. In our empirical study we will show that customer from the same market segment can buy a product from a higher category, if its price is acceptable for him or vice versa a product from a lower category in which given the relatively low price he is not so demanding. Many attributes of quality of a product from the middle category that could seem linear can be perceived as attractive for a product from a lower category etc.

Kano's exploration is usually made within particular market segment that is composed of customers who are similar from the demographic, social, or geographic point of view. Let us consider a market segment from which we have responses from *J* respondents at our disposal (Tkáč and Lyócsa, 2010).

For a specific product we will choose a group of attributes of a quality described as functional demands $F \equiv \{f_i | i = 1,2,...,I\}$. A research is done (Xu et al., 2009) for all respondents and for each functional demand (attribute of a quality) $f_i \ (\forall i = 1,2,...,I)$ in the meaning of functional and dysfunctional shape of Kano's questions.

The result of given exploration is then a set $e_{ij} = (x_{ij}, y_{ij}, w_{ij})$, where $\forall i = 1,2,...,I$ and $\forall j = 1,2,...,J$ and where x_{ij} is the response for dysfunctional question of a respondent $j \in J$ for f_i. y_{ij} is a response to the functional form of a Kano question from one respondent $j \in J$ for f_i and w_{ij} is the evaluation of significance f_i perceived by J respondent. Similarly, to DuMouchel (Berger et al., 1993), this access accepts a system of giving points described in Table 1.

Table 1 – Kano's questionnaire (Xu et al., 2009)

Kano's question	Answer	
Functional form of the question	I like it that way	1
	It must be that way	0.5
	I am neutral	0
	I can live with it that way	- 0.25
	I dislike it that way	- 0.5
Dysfucntional form ot the question	I like it that way	-0.5
	It must be that way	-0.25
	I am neutral	0
	I can live with it that way	0.5
	I dislike it that way	1

Using the evaluation of importance (Table 2) the weights w_i are assigned to individual f_i by each respondent.

Table 2 – Scores for self-stated importance (Xu et al., 2009)

	Not important		Somewhat important		Important		Very important		Extremely important	
	→									
w_i	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

In the following, therefore the average level of the response to dysfunctional Kano's questions for all respondents and for f_i is defined as $\overline{X}_i$ and the average level of satisfaction for functional form of question within the same segment of the market is defined as $\overline{Y}_i$, i.e.,

$$\overline{X}_i = \frac{1}{J}\sum_{j=1}^{J} w_{ij} \cdot x_{ij} \,,\; \overline{Y}_i = \frac{1}{J}\sum_{j=1}^{J} w_{ij} \cdot y_{ij} \,.$$

In two-dimensional space, the arranged pair of values $\left(\overline{X}_i, \overline{Y}_i\right)$ represents a vector that can be represented in a rectangular system as a point while the horizontal axis represents dysfunction score and vertical axis function score. In the following, we will consider only the first quadrant of a system. The majority of $\left(\overline{X}_i, \overline{Y}_i\right)$ should be moving between 0 to 1, because negative values are a result of disputable or reverse categories. At these values, we will act in line with Xu et al. (2009). By transforming the Cartesian coordinates to polar, we can assign to each attribute of a quality f_i, which is represented by a vector $\left(\overline{X}_i, \overline{Y}_i\right)$, a number $r_i = \sqrt{\overline{X}_i^2 + \overline{Y}_i^2}$ representing a size of a vector $\left(\overline{X}_i, \overline{Y}_i\right)$ and a value of an angle $\alpha_i = \tan^{-1}\left(\overline{Y}_i / \overline{X}_i\right)$ representing the angle between horizontal axis and r_i. For each

attribute of a size of a vector (r_i), $0 \le r_i \le \sqrt{2}$ and $0 \le \alpha_i \le \pi/2$ is called the index of importance and for angle α_i, $\alpha_i = \pi/2$ is called the index of satisfaction.

In extreme situation, $\alpha_i = 0$ means that dysfunction f_i causes dissatisfaction while functioning f_i does not increase the satisfaction and therefore is ideal, must-be element (Figure 2). On the contrary $\alpha_i = \pi/2$ means that f_i is ideal attractive element. In A-Kano's model there are described only first four categories i.e. negative values are excluded from the model (Xu et al., 2009).

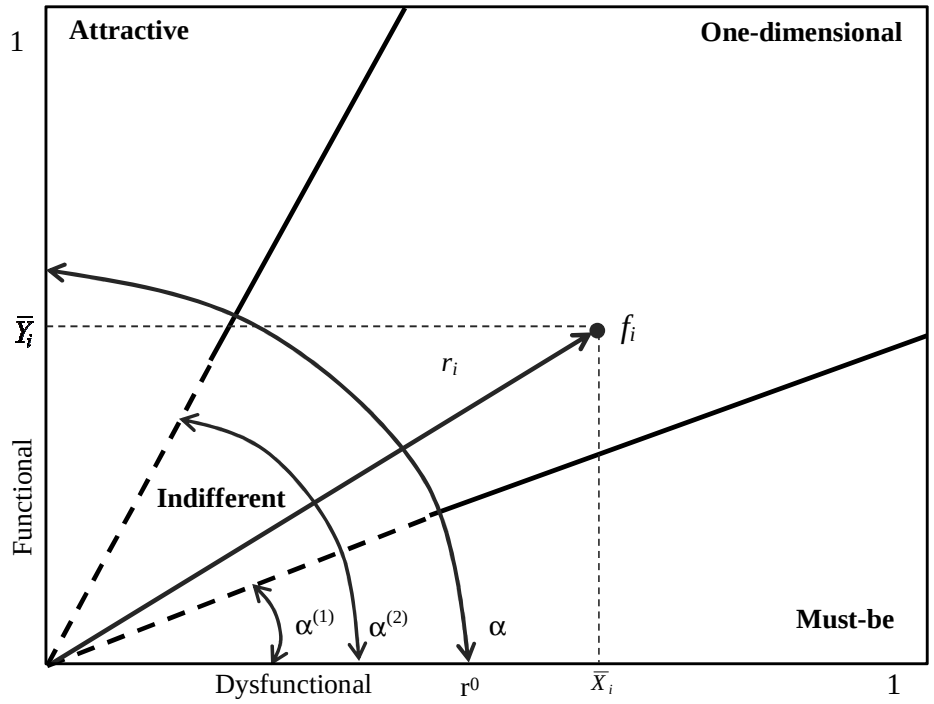

Figure 2 –The analytical Kano's model (Lee et al., 2012)

4 CASE STUDY

In our empirical study we applied the Kano's model to evaluate the attractiveness of quality attributes of a product – cell phone. The group of respondents was created of 223 technically oriented university students. The choice of a product was made due to the availability for all respondents. Given that some of the students had more than one cell phone, they were asked to evaluate the attractiveness of their last bought device. The Kano's model was therefore applied in evaluating the perceived quality of a product that has been already purchased by respondents. The classic Kano's questions (Table 1) have been

supplemented by a question about the type and brand of a mobile phone and approximate date of a purchase.

Furthermore, there was also a question about a monthly income of a family from which the student comes. The nineteen attributes of a quality have been chosen (Table 3).

To each of above mentionned nineteen attributes the respondent assigned the importance in the meaning of (Xu et al., 2009) according to the scale described in Table 2.

The last question of a questionnaire was open. A respondent has been challenged to briefly describe the reasons of his decision. The outcome of a research mentioned above was analysed by the analytical A-Kano‘s model according to Lee, et al. (2012) and Xu et al. (2009).

Table 3 – Attributes of quality

Attribute No	Attribute of quality
1	Flexibility of a shape (possibility of tipping, ejecting, opening)
2	Possibility of choice of a color
3	Possibility of wifi, bluetooth connection
4	GPS
5	Size of the screen
6	Low weight
7	Little thickness
8	Duration of a call on one charge
9	Size of a user memory
10	Simplicity of operation
11	High resolution of a camera
12	Simple connection of a charger
13	Short time of charging
14	Touch screen
15	Dual sim
16	Listening of MP3 - MP3 playback
17	Water resistance
18	Dust resistance
19	Impact resistance

The information about a monthly family income has been used for a specification of a market segment. Into the sample there were included only respondents (191) whose family incomes were from 800 to 2000 euros. The respondents were from the same demographic region and were young people at the age from 19 to 23 years. The study was focused on determination of attractiveness of a cell phone since all of respondents had sufficient experience with the use of a product. We have looked up on the internet the lowest available price in time of evaluating the questionnaire for each type of a mobile phone listed in a questionnaire (94). The reason was to decrease the variability of individual prices caused by different sellers, special offers and changes of price in time. The object of the research was not total costs associated with the use of a product but a price since we assumed

the operational costs associated with the use of a mobile phone are for all types of phones approximately the same. Based on a price gained we have sorted out the questionnaires into different price categories as it is seen in the Table 4. Similarly as in the previous studies (Xu et al., 2009), we have matched numeric values to the individual questions in Kano's model (Table 4).

Table 4 – Price borders

Class		Subclass		Cost (Eur)	Number of respondents
Lower	1	lower	1;1	0 - 100	15
		middle	1;2	100-150	48
		upper	1;3	150-200	23
Middle	2	lower	2;1	200-250	33
		middle	2;2	250-300	12
		upper	2;3	300-350	26
Upper	3	lower	3;1	350-400	4
		middle	3;2	400-450	8
		upper	3;3	> 450	22

Unlike the (Lee et al., 2012) we have not aimed at exact determination of individual category of attractiveness but we have emerged from the assumption that the higher the value of r is, the individual attribute of a quality is more important from the view of a customer. A number α in their size determines some kind of rate of attractiveness of attribute of a quality from the smallest must-be by middle one-dimensional to the most attractive.

Since in our study we compare the individual quality attributes evaluated according to price categories, we will consider given attribute more attractive if it has higher α and more important, if it has higher r value without exact determination of border values for individual areas of attractiveness.

In evaluating a study, each questionnaire was included into price category according to the estimated price of mobile telephone. Final values $\bar{x}$, $\bar{y}$ for individual price categories are described in Figure 3.

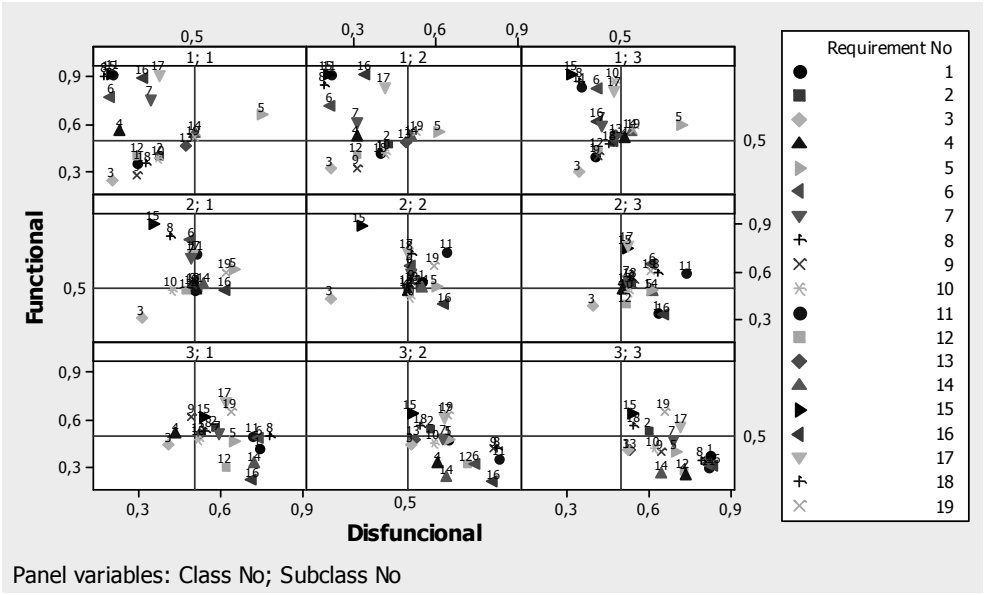

Figure 3 – Scatter plot of Functional vs Disfuncional

From the figure above, we can see some movement of evaluation of attractiveness from upper left corner to lower right corner for each attribute of quality depending on price category to which the respondents were classified according to the purchase of cell phone. In lower price categories the majority of attributes of a quality is perceived as non-important or attractive (left quadrants). In higher price categories is the majority of the same attributes of quality considered as must-be or one-dimensional (right quadrants).

For the more exact determination of level of attractiveness we will use the satisfaction index α depending on the price categories for each attribute of quality (Figure 4). In the figure there are presented regression lines describing the change of α (axis y) for individual price categories (axis x) and for all studied attributes of quality for individual figures. All regression lines assigned to individual attributes of quality are non-growing while in the attributes 1, 4, 6, 7, 8, 11, 12, 15, 16, 17 the descending trend was detected. It is a decrease of parameter of atractiveness α depending on price category of a product. Given decrease indicates that the same attribute of a quality is less attractive at a higher price level of a product. Regarding their sepparation into price sub-classes, one-way ANOVA has been performed for the values of α for individual attributes of quality, which unambiguously demonstrated $(p < 0{,}0001)$ the change of values of satisfaction index α in accordance to particular price sub-classes. After the data transformation (due to presence of heteroscedasticity), the one-way ANOVA has been also done for values of r. In case of importance index r, the heterogeneity of values has not been proved $(p = 0{,}148)$ for individual price sub-classes.

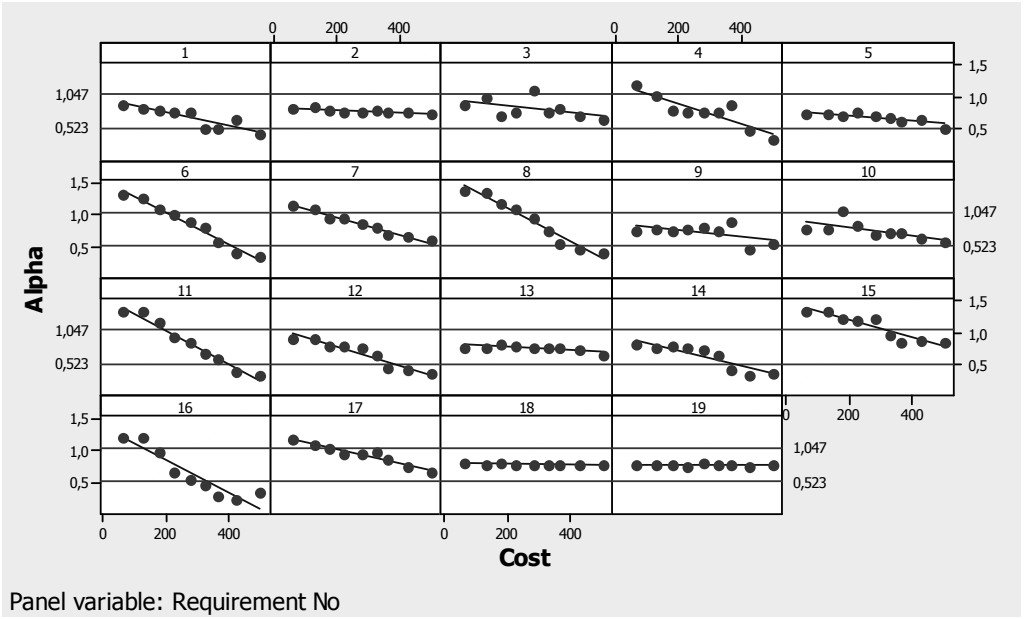

Figure 4 – Scatter plot of Alpha vs Cost

Figure 5 illustrates the boxplot analysis of parameters α and r for individual sub-classes.

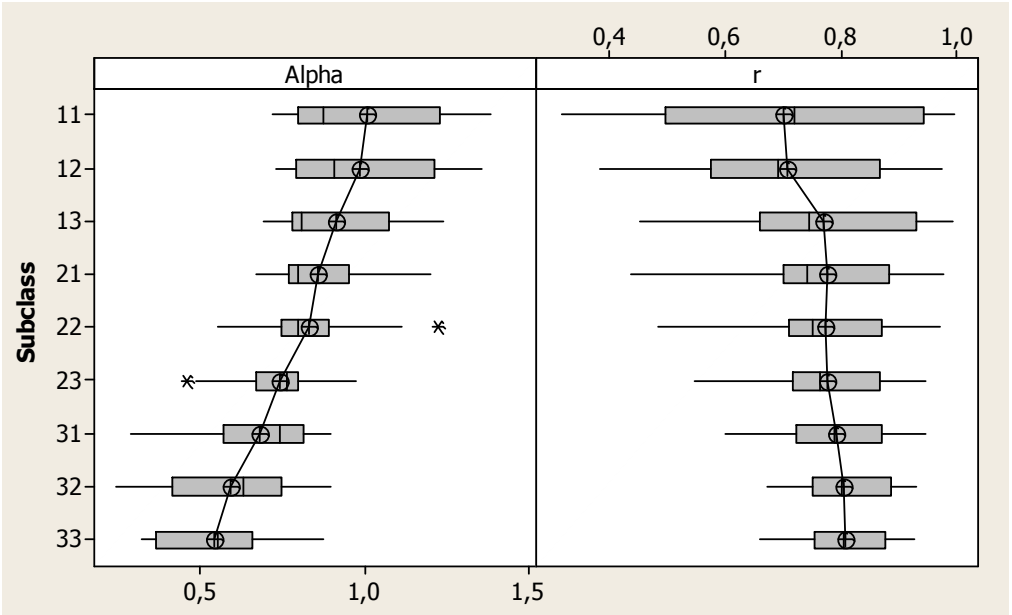

Figure 5 – Boxplot of Alpha and r vs Subclass

In order to compare the outcomes of our study we present selected five technical attributes of quality.

Based on the internet research, we found besides the price also specific technical parameters of all 94 examined cell phones possessed by respondents (Figure 6). These are *W* – weight of cell phone (g), *T* – time of continual talk on one charging of the battery (min), *R* – size of RAM (MB), *D* – size display (inch) and *C* – resolution of the camera (MPx). On the axis x there is illustrated the price of every cell phone type that occurred in the research. Axis y presents the specific numerical value of given technical attribute of quality of every cell phone in question as declared by manufacturer.

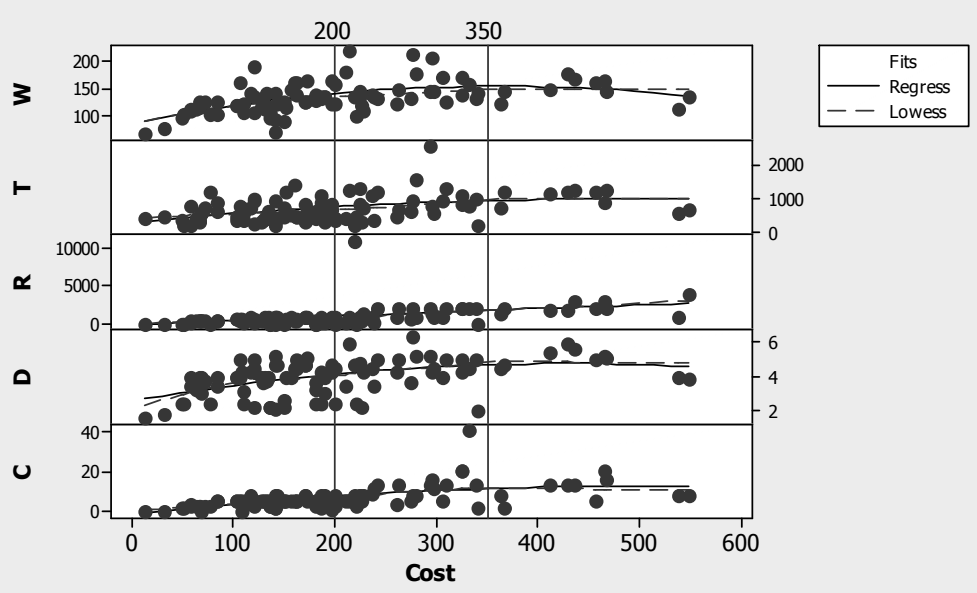

Figure 6 – Matrix plot of W; T; R; D; C vs Cost

5 CONCLUSION

The presented case study suggests certain dynamics of quality perceived by customers regarding the price level of purchased product. Significant differences have been observed considering the index of satisfaction α. In case of importance index r, the influence of price levels has not been proven.

In other words, the present study suggests the existence of a relationship between the total cost of product (often only the price of product) and the customer's perception of the attractiveness of its quality attributes. Based on a group of respondents (191), we have shown that a lower price, namely the inclusion of the product in the lower price class is manifested with the customer so that some other quality attributes of the product seem more attractive to him/her. Interestingly, a similar relationship was not recorded in the perception of the importance of individual product attributes. Very simply said, a decrease of the price increases the attractiveness but not the importance of individual quality attributes.

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AKNOWLEDGEMENT

This contribution is the result of the project implementation: This contribution is the result of the project implementation: VEGA No. 1/0150/15 - Development of new method of implementation and verification of integrated machinery safety systems equipmnet systems and industry technology.

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