The Role of Conjoint Analysis in the New Product Price Sensibility Research

UDC: 658.8.031 ; 338.516.49

Marija Kuzmanović, Tijana Obradović
Faculty of Organizational Sciences

It is very important that in the new product development process we should be able to predict its sales price. The pricing strategy is largely responsible for whether the prospective customers will accept the new product as well as for the income to be earned from its sale. In defining the pricing strategy it is necessary that, besides the price elasticity, we pay attention to the customer demand elasticity, in terms of customer preferences, their perception of value and the very situation in which the product is purchased. Many methods are at our disposal when it comes to obtaining a thorough insight into customers' demands, and, in view of the presumptions on which they are based, they yield different levels of useful information. This paper presents the model of individual elasticity of demand and a review of methods most commonly implemented in pricing research with special emphasis on the conjoint analysis. The conclusion that is drawn is that the traditional conjoint analysis and the choice based conjoint analysis are the methods that yield best results in pricing research conducted both in the early phases of the new product development and throughout their launching and the entire life cycle.

1. Introduction

It is important that in each phase of the new product development the customers' response to the product characteristics, aspecially its price be predicted. The price sensitivity analysis is a very popular research technique because it is relatively simple to conduct, it can be quantified, and it yields the results which are a good basis for decision making. The errors related to the price sensitivity estimate may, however, mislead the managers to draw wrong conclusions, or to disregard other components of individual price elasticity, such as the customers' system of values and situational factors. The knowledge of the customers' perception of the appropriate, or fair price of the product is not enough to predict a probability that the customer will buy the product. A more complete picture of individual price sensibility requires a model that consists of price sensibility and the factors motivating the customer to purchase.

In the early phases of the new product development it is possible to define a large number of product concepts, however, each of them has to have a defined price. Hence the pricing strategy largely defines the acceptance of a new product by the prospective customers and the income to be gained from its sale. Vithala Rao claims that "the price is the only element of the marketing mix that generates income; all the other elements create costs" [11]. Therefore the price should be observed in each phase of the new product development. In the analysis of different concepts the price may prove to be a barrier for further development. In the process of product development the price is the input data related to making decisions as to the production costs. In launching the product, the price is the basic element of the income maximization strategy, the income to be earned throughout the life cycle of the product. The identification of the individual elasticity of demand can, therefore, prove to be a useful way of developing marketing mix and pricing strategy and of identifying the key segments of the market.

New products are introduced to the markets that have little or no information on the comparable prices for the product. The crucial problem related to new products is the customers' uncertainty of the value the product will have for them. Hence one of the most important functions of marketing is to help prospective buyer to develop his/her own subjective measure of the product's value, which will be a function of his perception of his needs. The research may help define the customers' value systems, so that the product should be created as related to these systems and positioned on the market in relation to these attributes.

On the other hand, in launching the product on the market that already has the products of the same purpose (substitutes), it is necessary that the impact of competitive products upon the demand elasticity of the new product should be examined too.

Pricing research can use a number of methods, varying in accordance to their capability of providing quality information on the customer preferences, which in turn affect price elasticity. The direct observation, the van Westendorp method, the traditional conjoint analysis, the discrete choice modelling are only some of the methods that allow for getting an insight into the customer behaviour.

2. Demand elasticity, price sensitivity and customer value

The price elasticity of demand is a concept traditionally related to markets and market segments, rather than to individuals and is a measure in which the market demand for a certain product change due to the change of its price. Formally, price elasticity is a ratio between the percentage change of the quantity of the product demanded and the percentage change in price, and can be expressed as follows:

$$E = \frac{\%\Delta q}{\%\Delta p} = \frac{\Delta q / q}{\Delta p / p} = \frac{\Delta q}{\Delta p} \cdot \frac{p}{q},$$

where q and p are the quantity and price of the product, respectively. When the elasticity coefficient exceeds 1, the demand is elastic, that is, the demand is sensitive to the change in price. When this coefficient is lower than 1, we deal with an inelastic demend, one that is not sensitive to changes in price.

Price elasticity is a measure of an individual or of market segments response to changes in price. Poor price elasticity means that an individual is willing to tolerate high price to obtain the product. The individuals that display a high price sensibility will consequently avoid high-price products.

The price elasticity measure, however, does not yield enough information to predict demand, hence the data obtained solely on the basis of the reaction to price are not enough to define the elasticity of market demand. It is also necessary to analyse other impacts, such as the brand reputation, advertising level, delivery promptness, etc.

Price sensibility cannot be isolated from the stimuli that cause it, nor from the situation in which it exists, as the data obtained at that moment are useless. The research that include the data on customer preferences can be used for market segmentation, product improvement and sale, by affecting the preferences that reduce the demand sensitivity.

A useful measure of individual elasticity of demand is the probability that an individual will buy the product at a given price, in a given situation. This can be extended to the distribution of probability of purchasing at different prices, which can be further applied to market segments in order to get the demand elasticity of a given segment.

Basically, there are two components of the demand elasticity measure: price elasticity and customer values that also include situational factors. Since the customer value factors can be in correlation with the intention to purchase, the customer values and the price sensitivity together make a good model of individual demand elasticity. The prospective customer may find the product price to be rather acceptable, however, he still does not intend to buy the product. A vegetarian may be aware of the price of beef, however, the translation of his price awareness into the demand measure without taking into consideration his eating habits is meaningless. In their research, Jamieson and Bass [4] use five factors to describe purchasing intentions. These are the product awareness, the product attractiveness, the prospective buyer's financial solvency/capability, the buyer's tendency to consult somebody on the purchase and the product availability. Other researchers propose similar sets of variables that affect price sensibility, common to all of them, however, being that the model includes the variables related to the situation, the product itself and the customer. One of the best models is that proposed by Harmon and Laird [3], presented in Figure 1. This model, together with the data obtained in the research, makes a good basis for marketing decision making.

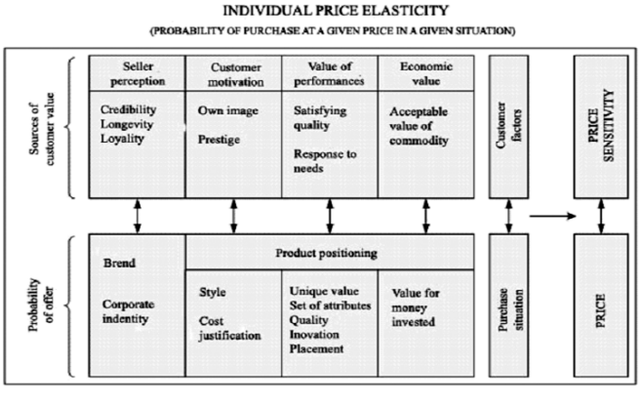


Figure 1: *Demand elasticity factors [4]*

The model in Figure 1 presents the sources of price elasticity, as well as the manner in which the value of the demand, including the product concept, the situation and the price, affects these factors so that they should result into a potential purchase. In the purchase situation, the value of the offer has to answer the sources of customer values in every category – the product must satisfy the customer needs. The situation has to be such that it satisfies the stimuli – the product has to be available, the buyer has to be aware of it, the location has to be appropriate and the transaction has to be possible. Finally, the price has to be reasonable, acceptable and fair.

3. Price sensitivity research methods

The practice knows a number of methods used in defining price sensitivity. One group of methods is based on direct observation to obtain an explicit measure of price sensitivity, whereas the other group of methods is based on indirect reasearch, i.e., price sensitivity is a derived value. The method that belongs to the former group and is most com-

monly implemented in practice is the van Westendorp method, while the latter includes the methods used to measure customer preferences, the Traditional conjoint analysis and the Choice based conjoint analysis.

3.1. Direct observation research

One question marketers most often ask in market research is "How much are you willing to pay for ...?" the data gathered in this way, however, may lead to wrong conclusions for several reasons. Firstly, one and the same question combines the price and the purchase intention. The respondent may believe that the product is worth an amount of money, however, he does not need the product. The measure of the perceived price of the product and the intention to buy it should, therefore, be analysed separately. Secondly, the respondent's answer will often be conditioned by the situation he is in. The respondents may enter discussion or debate on prices, thus hindering the research, or they may tend to satisfy the researcher attaching to the price much more importance than necessary. Some customers link the price of the product with its quality, or they are not really familiar with "reference" prices of similar products on a stready market, especially if the product is new.

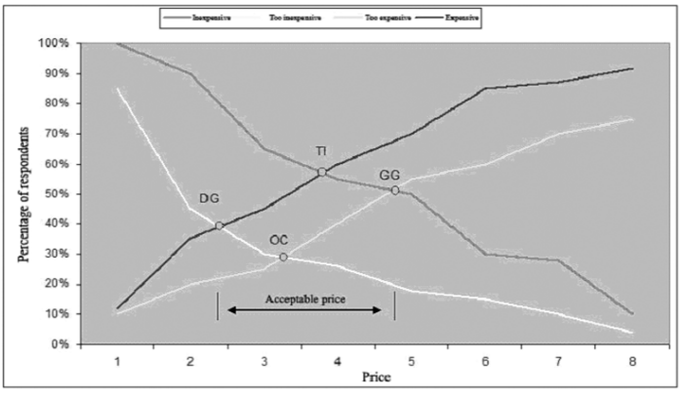
3.2. Van Westendorp method (VWSM)

In 1970's, Peter H. van Westendorp, a Dutch economist, proposed a method for measuring customer perception as regards price. The method is based on the premise that there is a scope of prices whose boundaries are, on one hand, the maximum price the customer is willing to pay, and, on the other, the minimum price below which the quality of the product is doubtful.

This method is also known as the *Price Sensitivity Measurement* (PSM) and is a relatively simple and inexpensive method using a graphic presentation to find an acceptable price scope. The model is based on the research in which the respondent is asked four questions for each described product:

1.) Which price do you find low for a given product? (inexpensive)
2.) Which price do you find high for a given product? (expensive)
3.) Which price would be low enough to make the quality of the product disputable? (too inexpensive)
4.) Which price would be high enough to make you abandon the idea of buying the product? (too expensive)

On the basis of the responses, each of the questions is assigned a cummulative distribution of frequencies which are entered into the graph, where the *x*-axis denotes the price, and the *y*-axis shows the number of respondents. The point of intersection of the curves obtained on the basis of the answers to the first two questions is the "indifference point" – (IP). It represents the price which an equal number of respondents find to be either high or low. The intersection of the other two curves, obtained from the answers to the third and the fourth questions is the "optimum price" – (OP) and represents the price which an equal number of respondents find to be too low or too high (Figure 2). The point in which a the number of respondents who regard the price to be high is equal to the number of those who regard it to be too low is the "lower limit for price" – (LL), whereas the point in which the number of respondents who find the product to be too expensive equals the number of those who find it in-



expensive is called the "upper limit for price" – (UL).
Figure 2: *Van Westendorp method*

The original van Westendorp model assumes that the acceptable price of the product ranges between the lower and the upper limits, the "Indifference point" is the commonest price of the product or the price of the product – market leader, whereas the point of the "optimum price" actually represents the ideal price.

Van Westendorp, however, argues that a number of products on the already established markets (the existing markets) have the prices that are not within the given range of acceptable prices.

3.3. Traditional Conjoint Analysis

The Conjoint Analysis is a research technique based on the multivariation analysis, used to define optimal characteristics of a product or a service, to measure individual preferences, to understand and anticipate the customer behaviour in new situations. This is a decomposite method which assumes that the product/service can be "decomposed" to its attributive components and which implies measuring cumulative effects of a larger number of the product/service attributes on the customer preferences.

The name of the method comes from its very nature, namely, the product attributes are CONsidered JOINTly. One reason for this is that the customer does not make a decision on purchase on the basis of just one characteristic, but takes into consideration all the characteristics of the product simultaneously.

The basic premise of the decomposite approach is that the customers evaluate the total *utility* of the product/service in that they combine individual *partial utilities* of the attribute levels describing the given product, where the partial utilities of the attribute are defined as numeric values reflecting the extent to which different product characteristics are desirable.
Using one set of both quantitative and qualitative attributes, including the price, the researchers in the conjoint analysis define a set of alternative products, i.e., profiles (Figure 3) which may be realistic or hypothetical. They then eliminate from the set any impossible combinations such as a high quality product at low price.

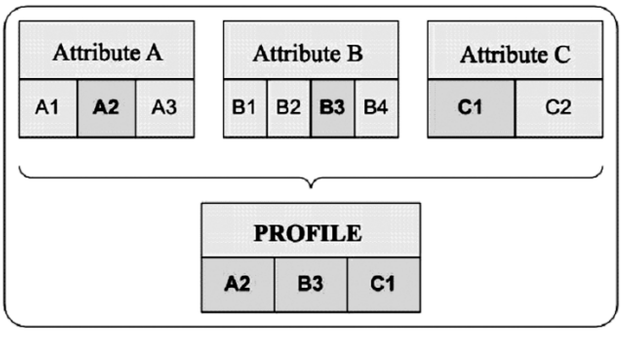


Figure 3. *Relations between the profile, the attribute and the attribute level*

Products are described by a set of attributes that take different values, from lowest to highest, therefore, to establish an overall attitude towards the product, the customers evaluate the total utility of all the attribute values simultaneously, through ranking or assessing each of the combinations (Figure 4).

Using a 10 point scale where 0 means certainly NOT and 10 certainly YES, answer the following:

Which is the probability that you buy a printer of the following characteristics...

HP
printing 12 pages/min
prints maximum 5000 pages
no possibility of reverse print
at a price of 250€

Your answer: _____

Figure 4. *Profile assessment*

On the basis of the total of customer attitudes it is possible to estimate partial utilities for certain attribute levels, using some of the composition rules. These rules serve to explain the structure of individual preferences of the customers. They help explain the manner in which the respondent combines part-worth utilities of each of the attribute levels into the total utility of the product (Figure 5).

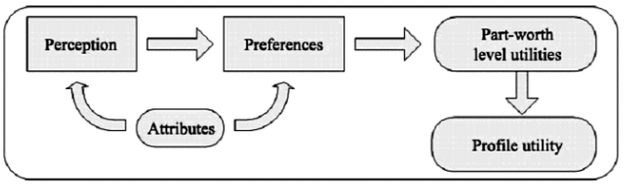


Figure 5. *Utility calculation process*

The total utility of the product j for the i – respondent can be expressed as follows:

$$U_{ij} = \sum_{k=1}^{K} \sum_{l=1}^{L_k} \beta_{ikl}\, x_{jkl}$$

where K is the total number of attributes, $k = 1, ..., K$, L_k is the number of k-attribute levels, $l = 1, ..., L_k$, and β_{ikl} is the utility of the l- level of k- attribute for the i-respondent (i- segment). The variable x_{jkl} takes the value l if the l-level of k-attribute is presented in the j profile, otherwise, it takes the value of 0.

In calculating the part-worth utilities the traditional conjoint analysis commonly uses the least square method and the monotonic regression (analysis).

The conjoint data can be used in determining the price sensitivity, but also all the other attributes included in the research. The part-worth utilities of each of the price levels offer a unique measure of the market or a market-segment sensibility to the change in price. When interactions between price and other attributes are calculated, it is possible to determine whether and in which manner the price sensitivity varies in relation to brand and other attributes. The price sensitivity of a brand with a strong image is usually lesser compared to that of an unknown brand.

The part-worth utilities can further be used to obtain a range of useful information on customer preferences, such as the attribute relative importance, the customer utility functions, the preference shares, as well as to define a model to simulate the customer choice behaviour for the predicting purposes.

$$R = \beta_{ikl} - \beta_{ikl*},$$

A relative attribute importance is a measure to which the attribute impacts the customer's choice and equals the difference between the greatest and the least utilities of the level of a given attribute, namely:

where l is the level with the highest utility value, and l^* is the level of the lowest value for the utility within the k-attribute. The higher the value, the more important the attribute for the respondent or a group of respondents. In practice, the relative attribute importance is commonly used in market segmentation based on customer preferences.

The utility function helps determine the individual sensitivities of the attribute value perceived to the change in its values. These functions are unique for any individual customer. The flatter the function, the lesser the attribute sensitivity.

Hence the attribute sensitivity can vary for different ranges of attribute value, and it is the utility function that helps getting an insight into this (Figure 6). For example, we can see in Figure 6 that all the attributes are highly sensitive to the level change. As regards the "price" attribute, for example, we can see that the rise in price from € 200 to € 250 reduces the utility to a small degree, whereas the rise from € 250 to € 400 reduces the utility, and consequently the respondents' preferencies, to a considerable extent.

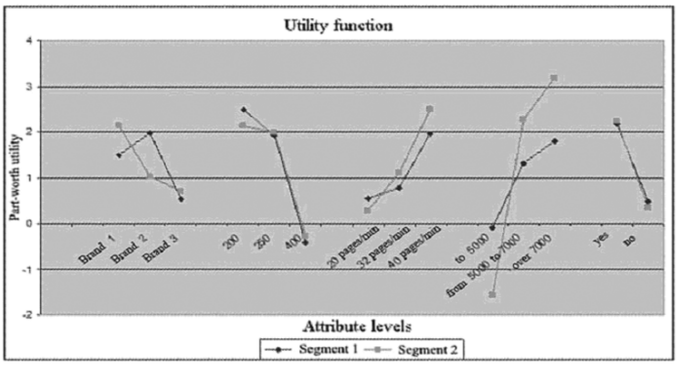


Figure 6. *Individual utility functions*

The utility functions, however, yield information only on the sensitivity of the attribute level utility, not on the demand sensitivity in general. To measure the demand sensitivity it is necessary that, using these data, the preference share and then a potential market share be determined.

To determine the product preference share the Logit model is most commonly implemented. This model does not assume that the respondents always decide in favour of purchasing the product with the greatest total utility. This is because, in making their decisions, the customers do not conduct detailed calculations. Instead, they base their assessment on a less precise notation of utility.

The Logit model employs the exponential transformation to translate the product utilities into the *preference shares*. The transformation has the following form:

$$P_{ij} = \frac{e^{bU_{ij}}}{\sum_{j=1}^{m} e^{bU_{ij}}}$$

where P_{ij} is the preference share of the j- profile for the i- respondent, while U_{ij} is the utility of the j- profile for the i- respondent. By definition, the "exponent" b has the value l and is used to fine-tune the results, so that they reflect the current customer behaviour on the market more accurately.

The preference share of a product, however, does not always represent its market share. It represents the share the product could have if there were no external variables to influence the customer's choice. This is because the awareness and the availability of the product often limit the prospect of purchasing the product. Namely, in case preference shares of two products are equal, the one that is characterised by higher awareness and distribution will have a larger market share.

The most commonly implemented method for the regulation of external variable impact upon conjoint data is weighting the preference share of each product by its *visibility*. The product visibility is a measure of its chances to be in the shop. This visibility is a combination of the awareness of the product and the value of distribution. For example, if a product is available in 50% of shops, it can achieve 50% of awareness in these shops and therefore achieve a 25% visibility (50%*50%). Another product may be available in 75% of shops and have a 67% awareness in these shops, achieving a visibility of 50% (75%*67%). The ratio between the preference shares of these two products after the transformation caused by the external variables impact can change drastically. Namely, the product with a larger preference share may have a smaller market share if its visibility on the market is smaller than the other product's visibility.

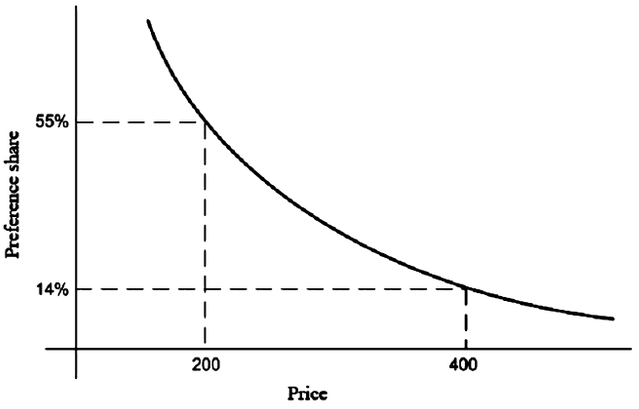


Figure 7. *Conjoint simulation and price sensitivity*

The conjoint analysis allows for conducting a simulation of the market reaction to different price levels in order to estimate the consequences this change may cause (Figure 7) in competitive conditions. However, when the product is entirelly new on the market and has no direct competition, the simulation, i.e., the definition of price sensitivity can be conducted as regards the option that the customers will not buy the given product.

3.4. The Choice Based Conjoint Analysis

The Choice Based Conjoint Analysis (CBC), or, as literature also calls it the Discrete Choice Modelling (DCM), is one of the conjoint methods. Contrary to the approach based of preferences (the traditional conjoint analysis) that stems from the marketing practice and is predominantly focused upon apprehending customer preferences, the choice based approach comes from the economics discipline and is implemented in assessing a wide scope of products and services [9].

Similar to the traditional conjoint analysis, the choice based conjoint analysis is one from the set of decomposite methods, however, it differs from the traditional one by the manner in which it presents the questions to the respondents.

There is a range of types of discrete choice models. Common to all of them is the choice scenario with a description of manifold sets of products whose prices range within a certain interval. The scenarios may vary from respondent to respondent, with different sets of tasks or with different prices for the target product presented in scenarios as well as in different aggregate data obtained. The choice task may be viewed as a set of alternative products, where the respondent is expected to choose the best (Figure 8). The choice itself turns the attention from evaluation of alternatives and estimate of the differences among them, which is characteristic of the traditional conjoint analysis, to the choice of the best product from the set of the ones on offer. In this way evaluation is by far more simplified. In fact, the respondents do not evaluate each product separately, but look for the dominant product, and if they do not find it, they try to eliminate the one whose attributes are least important. It is in this way that they find the best of the alternatives offered and they make their choice.

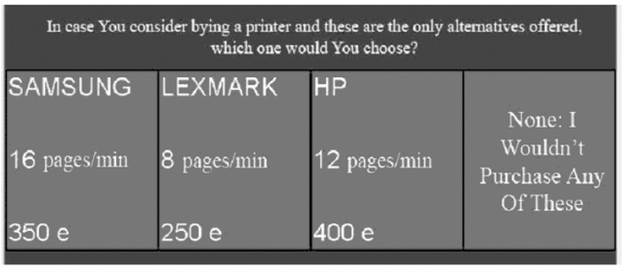


Figure 8. *The task of making choice from a set of alternatives offered*

The method became popular in the early 1990s due to its similarity to real situations in which the customers make decisions on purchasing one product or another. One important advantage of this method is that it can include the answers such as "none offered", or multiple answers. This characteristic is very important as regards the fact that in reality each decision-making process ends up in the customer buying the product. By choosing the option "none offered" the respondent contributes the information on the change in demand caused by too high prices of the products on offer, or by the products becoming inattractive for any other reasons.

By its structure, the information obtained by the CBC is very similar to that yielded by the traditional conjoint analysis, the only difference being that in the CBS the preferences are calculated on the aggregate level, applying the Logit model. The choice based conjoint analysis, too, offers a possibility of simulation to determine the sensitivity of preference and demand to the change in price or other attributes covered by the research.

4. Comparative review of methods

Table 1 presents a comparative review of four research methods described in the chapter above. The characteristics of the methods presented in the table are largely simplified; in practice, the value of each of the methods depends on the extent to which the reasearch is planned and conducted and to which the findings are well used.

Much pricing research is based on the assumptions that the decisions on purchasing are motivated by economic

value, with preferences often being neglected. What makes a difference between the useful research from those whose findings are misleading is the significance of difference between the assumptions on which the model is based and the real situations in which the customers actually make decisions.

The van Westendorp method of price sensitivity measurement (VWPSM) does not provide the insight into the customer values that encourage decision-making on purchasing. Since this type of research combines the intention factors with price sensitivity, the research findings may be misleading.

Presented options	One product for all respondents	One product	Sets of product characteristics (attrributes) Real and hypothetical products.	Set of products described by price and characteristics.
Questions put to respondents	How much are you willing to pay for...?	The highest and the lowest price levels percieved	Product evaluation and ranking	Which of the products offered would you buy? (choice from the set of offered products, with the possibility of choosing the option *none*)
Assumptions	Respondents know how much they are willing to pay.	The range of acceptable prices is known for each respondent.	Respondents are aware of the attributes they prefer.	Models realistic purchase conditions.
Focus	Intention to purchase a product at one price	Price	Attributes, Price	Products, Price
Information obtained	One price	Optimum or fair price as well as acceptable range of price	Optimum combination of attributes Part-worth utilities of attributes, including the price Attribute sensitivity in competitive conditions and a potential market share	Optimum product Prospective market share.

Table 1: *Comparative review of price sensitivity reasearch methods*

The Conjoint analysis is both a technique appropriate for defining the new product prices and a good tool to gather data on preferences for the potential products attributes in the early phases of a new product development, but throughout its life cycle as well. By balancing between the characteristics and the price it is possible to decompose the precieved utility of the product as a whole into part-worth utilities the customers assign to each of the characteristics. These part-worth utilities may be useful in determining price sensitivity, but also all the other attributes covered by the research. An especially important advantage of the Conjoint analysis in pricing research is that it takes into account the competition interactions and the potential impact of substitutes upon the demand for a given product.

The Discrete choice modelling has a number of advantages in pricing research concerned with the new and the existing products. It is a model that is much more similar to realistic purchase situations, however, the hypotetical situational variables may be included into the research if necessary, to simulate the purchase situation. While the traditional conjoint analysis can identify the importance of the product attributes, the findings of the choice based conjoint analysis can determine the preceived value of the product as regards the competitive products.

5. Conclusion

In the early phases of the new product development the analysis of customer value has an important impact upon decision making. Very important, too, is the opportunity to use the market research in the new product definition phase in order to identify both the attributes that enhance purchasing, and their best combinations in the product. In the subsequent phases the most favourable characteristics of the products are improved, by influencing the unique customer value factors and reducing the product price sensitivity. Even when the product has all the characteristics the customers expect, it is necessary that data on customer preferences be collected, in order that the product should be positioned on the market as favourably as possible, since, in any case, the price sensitivity of a product may vary in dependance of its positioning and the perception the customer has of it.

The paper presents a review of four pricing research methods. The comparison of these methods is conducted on the basis of their capabilities to yield data on customer preferences and the price sensitivity required to form a full insight into individual demand. Here, the traditional conjoint analysis and the choice based conjoint analysis have proved to be the best methods for an early market research of new products, since they include all the essential data on customer prefarences.

REFERENCE

[1] Duke, C.R., "Matching Appropriate Pricing Strategy with Markets and Objectives", *Journal of Product and Brand Management*, 3 (2) (1994) 15-27.

[2] Green, P.E., Krieger, A.M., "What's Right with Conjoint Analysis?", *Marketing Research*, 14(1) (2002).

[3] Harmon, R.R., and Laird, G.L., "Linking Marketing Strategy to Customer Value: Implications for Technology Marketers," Kocaoglu, et al. (Eds), Innovation in Technology Management: The Key to Global Leadership, PICMET, July 1997, 896-900.

[4] Jamieson, L.F., Bass, F.M., "Adjusting Stated Intention Measures to Predict Trial Purchase of New Products: A Comparison of Models and Methods", *Journal of Marketing Research*, 26 (1989) 336-45.

[5] Kuzmanović, M., "Primena Conjoint analize u definisanju marketing strategije", Menadžment, FON, 2005, 28-35

[6] Kuzmanović, M., *Kvantitativne metode u upravljanju marketingom: Primena conjoint analize*, Društvo operacionih istraživača, 2006.

[7] Kuzmanović, M., "To the Optimal Marketing Strategy Using Conjoint Simulation", SEEMAR06, 2006.

[8] Kuzmanović, M., "The Nonstandard Algorithm for Constructing Efficient Conjoint Experimental Designs", *Yugoslav Journal of Operations Research*, 18(1) (2008).

[9] Louviere, J., "Analyzing Decision Making: Metric Conjoint Analysis", Sage University Papers Series on Quantitative Applications in the Social Sciences, No 67, Newbury Park, California, 1988.

[10] Mahajan, V., Muller, E., Bass F., "New Product Diffusion Models in Marketing: A Review and Directions for Research," *Journal of Marketing*, 54 (1990).

[11] Rao, V.R., "Pricing Research in Marketing: The State of the Art", *Journal of Business*, 57 (1) (1984).

[12] Sullivan, P., "Comparing Price Sensitivity Research Models for New Products", Portland State University, August 2003.