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Value Analysis as an Integral Part of New Product Development

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Abstract

At the present moment, global competition between companies is leading to a constant battle for an adequate market share and this is mostly not only achieved by reducing prices but rather more effectively by constantly introducing new innovations at all levels and across all functions in a company. Conceptions or ideas for new products derive either from external sources (customers or buyers, suppliers, competitors, patent documentation, research centres and educational institutions, chambers, associations and institutes, fairs and exhibitions etc.) or internal sources (managers, sales representatives, merchants and commercial travellers, associate professionals and technologists, designers, in-house innovators etc.) [10]. Companies in the technical field mostly acquire knowledge on the basis of researching a special group of buyers known as the "leading users". These are the buyers who are the most advanced in terms of using a company's products and in comparison with others they identify possible improvements to products earlier. Companies use surveys, projective methods, group interviews as well as written customers' suggestions and complaints to identify the needs and wishes of their customers. However, it has to be said that many of the best ideas evolve from the problems customers have with existing products [7].
The very core of VA is the effort to determine and eliminate those characteristics of products or services with no real value for the customer or the product, but which, nevertheless, cause costs in the production process or service delivery. Therefore, the VA process ensures a better product or service for the customer at minimal costs compared to replacing the existing product with a less favourable alternative.
In the present article, the development of a new product is outlined in which the usefulness of two methods of innovative management – VA and conjoint analysis – was shown.

Keywords: value analysis; new product development; conjoint analysis; product's functions; cost function matrix

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1. Introduction

Producers in developed countries are forced to constantly devote their time to innovations if they want to keep or improve their competitive position in the global market. Moreover, the increased complexity of products and the maximum possible economy of scale of producers lead to the development of a virtual supply chain and to the concept of extended enterprises. Hereby we mean the production configuration in which the production process is divided between different companies; a situation typical for mature industrial sectors, such as the automotive, aeronautical and the shipbuilding industry [12]. In such a situation it is much more difficult to apply collaborative engineering techniques for the entire product due to the required information flow about the product and the related confidentiality and safety requirements.

A *product* can be defined as something that can satisfy a certain need or wish of the user [11]. The importance of physical products is not the pure fact that we owe them but it is important what the product has to offer. Physical products are only used to deliver services, and are only the packaging that has to fulfil a certain function. In a successful business system, a product must have all the necessary functions, for which we optimise costs – and this is the main purpose of Value Analysis (VA).

When a company develops a new product, it usually has to face with the problem of determining an appropriate price for this product. In the first step, the company has to define what it wants to achieve with the product, as this will basically take influence on the product's price range. If the company takes great care in choosing the target market and positions the product carefully, then it will be relatively easy to form the price strategy as well [4].

In the broadest sense, costs can be defined as everything the buyer has to give up in order to gain the advantages, which the supplier has to offer. Costs can be monetary or non- monetary (the time spent, risk, psychical effort, the energy used). Different factors can influence the advantage, such as: the quality of a product, the quality of the customer service and qualities, which are based on experiences [13].

Furthermore, we can add that a trademark also represents value for the customer. However, in every industry specific factors exist, which the customers consider to be of value.

In order for a product to be successful on the market, it must be [10]:

- adjusted to the needs, wishes and demands of the buyers,
- adapted to the buyers' financial capabilities,
- of quality, successful in its function and feature long-lasting usability,
- placed in the market at the right time.

1.1. Why to introduce VA in the product development process?

Ever since its beginnings, when Lawrence D. Miles developed it in 1947, Value Methodology (VM) has been used as an organised approach. Mostly described as Value Analysis, Value Engineering and Value Management, it is defined as a method used for systematically improving the "value" of goods or products and services, especially in terms of their "functions". VA turned out to be a very important means for improving the quality and reducing the costs of products/services in companies which use VA. At the same time these companies can systematically orient their knowledge and the creative flow and thus create efficient competitive advantages [2].

There are many reasons for a structured approach of the value analysis as a means of a logical cost reduction. These reasons can be divided according to their source – reasons found inside a company (insufficient information in terms of design) or reasons initiated by the product's or service's market (pricing, environmental protection, new technologies, materials etc.) [6].

Thus, even in countries where the use of VA only in its infancy, significant savings can be achieved, for example in Malaysia, where the 71 government projects had applied VA in the Value Management studies which in a month period had resulted in 23,53% of the monetary savings from the total cost [17].

The VA process enables the company to eliminate weaknesses at the time when production already started and therefore it stops paying for activities, which are of no value for the buyer, but only create costs, which are transferred to the buyer [16].

2. Basics of VA

The value analysis method is almost universal and can be used for analysing existing products or services offered by production companies as well as services providers. For new products the Value Engineering approach is used, which applies the same principles and many of the VA techniques in the "preproduction" stages, such as concept development, design and production of prototypes.

The basic principle – to offer value for the lowest or optimal production costs – directs all actions taken in the process of VA and enables the transformation of all improvement related ideas into commercial benefits for the company and its customers [16].

When applying VA, the first step is to create and later on to improve the value of a product/service by understanding its functions and values. The same is done with its components and the costs associated with them. With VA we strive to eliminate unnecessary costs without endangering any important functions or reducing the price without any reason. Such a cost reduction usually consists of a products quality improvement and other improvements, such as: reducing the interoperation time and weight, improving production, better functioning, greater security etc. [2].

Value Analysis is organised as a creative method which aims at precisely and effectively pointing out unnecessary costs – costs which do not contribute to quality, provide usefulness, prolong the product's lifespan or improve the external appearance of a product and other characteristics, desired by the customer. Value Analysis is a system which enables the user to solve complex problems, which cannot be completely or partially calculated by algorithms. The objects of a value analysis can therefore be products, operating systems, processes, services, administration, organisation etc. [9]

Value Analysis can be defined as a systematic overview process which is used for existing or new product models for comparing a product's functions chosen by the customer to fulfil his/her demands at the lowest possible price and in accordance with the stated performance and the required reliability [18].

Figure 1 presents the correlation between the value (satisfying the required functions of a product), the VA methodology (the 6 stages concept) and the implementation dynamics (a product intended for the market).

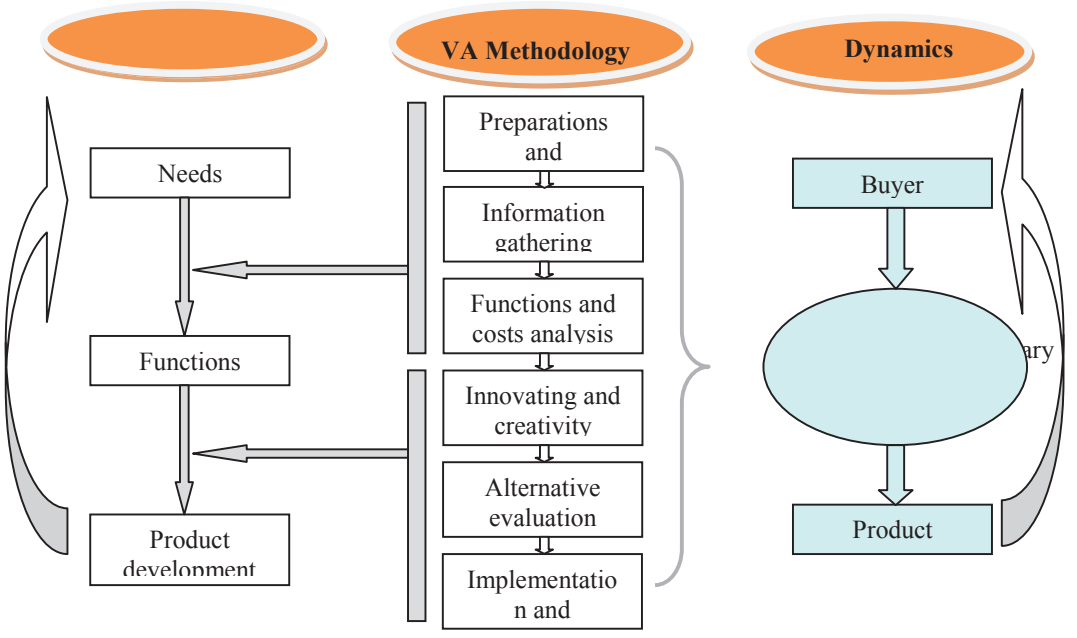


Fig.1. VA process [19].

3. Defining the product's functions

Our research was focused towards developing a special product for touring cyclists which enables attaching smartphones to a bicycle. Firstly, we identified the functions the product should have and in the next step we divided them according to the type and whether the function was new (Table 1).

Table 1. Defining the Product's Functions [18].

Seq. name	Name of function	Type of function					Function's new feature		
		basic	secondary	aesthetic	prestigious	existing	implemented	new	original
A	Enables clamping	X				X			
B	Enables fixation	X					X		
C	Enables rotation		X			X			
D	Protection from hits		X				X		
E	Protection from water		X					X	
F	Reduces vibrations		X					X	
G	Enables handling / use		X				X		
H	Protects the user	X					X		

As shown in table 2, to define the importance of each function the functions which were previously identified are compared with one another [18].

Table 2. Evaluating the importance (weight) of the functions.

	B	C	D	E	F	G	H		RR	W	P
A	*	A2	A3	A3	A2	A2	A3	**A**	15	10	1
	B	B1	B3	B3	B1	B2	B3	**B**	13	8,7	2
		C	C2	C2	C1	C2	C3	**C**	10	6,7	3
			D	D1	F1	G1	D2	**D**	3	2	6
				E	F1	G1	E2	**E**	2	1,3	7
					F	G2	F2	**F**	4	2,7	5
						G	G1	**G**	5	3,3	4
							H	**H**	0	0	8

Legend:

$$W = \frac{RR}{RR_{\max}} \cdot 10 \qquad (1)$$

W – individual function's weight
RR – rough function's result
P – place
1 – small difference
2 – medium difference
3 – large difference
* – equally important

Table 2 shows that function A "enables clamping" is the product's most important function. As regards the importance, the function "enables fixation" follows. This is understandable, because both functions are related and

one cannot exist without the other. On the third place is the function "enables rotation" which rounds up all three most important functions which received the highest grade. These functions are also responsible for the largest part of the costs and, therefore, the best possible solutions will be sought in the further process of VA.

4. Determining the costs of functions

When analysing the costs of a product's functions in a cost function matrix (Table 3), the implementation value of a product's individual function from a costs point of view becomes visible. We divided the price of the product, which was set on the basis of a market analysis, according to the components of the product and evaluated to what an extent each function is present in a component [19]. Based on the costs of the product's components we ascribe a share of the cost, which arise when a function is met, to each function.

Table 3. Costs of Individual Functions – Cost Function Matrix.

		FUNCTIONS															
COMPONENT	COSTS (EUR)	Enables clamping		Enables fixation		Enables rotation		Protect from hits		Protects from water		Reduces vibration		Enables handling/ use		Protects the user	
		%	S	%	S	%	S	%	S	%	S	%	S	%	S	%	S
Holder mounting device	5,00			45	2.25	25	1.25	5	0.25			20	1,00			5	0.25
Holder	7,00	40	2.80			20	1.40	20	1.40	10	0.70			5	0.35	5	0.35
Mechanism with film	4,00							20	0.80	70	2.80			10	0.40		
Fixation clips	1,50			80	1.20	20	0.30										
Foam rubber	1,00	50	0.50									50	0.50				
Locking mechanism	2,00	90	1.80											10	0.20		
Clamping inserts	1,50	60	0.90									30	0.45	10	0.15		
Fixation nuts	2,00			80	1.60	20	0.40										
SUM (EUR)	**24,00**		**6,00**		**5.05**		**3.35**		**2.45**		**3.50**		**1.95**		**1.10**		**0.60**

Based on the identified costs of individual functions**,** we can determine which elements must be given the greatest attention and especially which potential mistakes can be avoided and where the biggest savings can be made in case of cost optimisation.

5. Proposed Product Variants

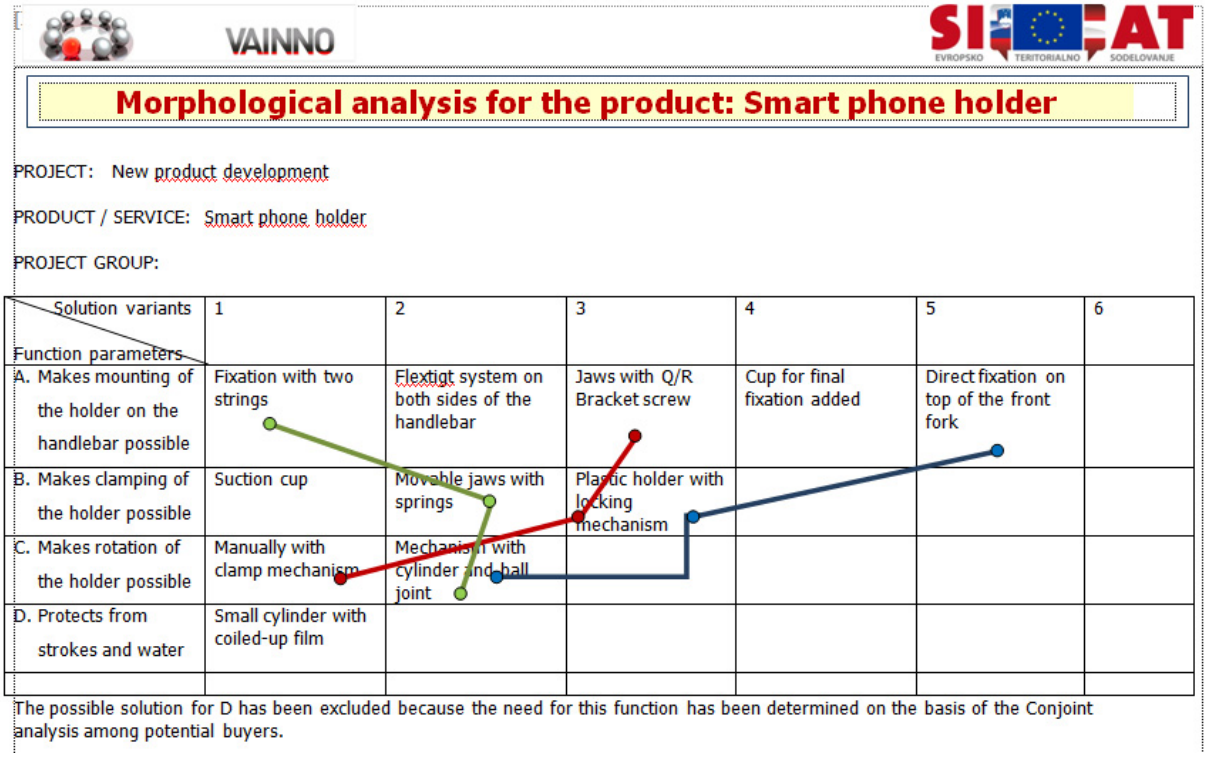
For the selection of possible problem-solving approaches a morphological matrix (see Fig. 2) was used, with the help of which those potential solutions for the product's functions were chosen, which best met the requirements set in the requirements sheet; this means variants, which fulfil those functions that have been evaluated as the most important ones. By combining the solutions, 3 alternatives of the product were chosen afterwards.

Solution 1: A1 → B2 → C2
Solution 2: A3 → B3 → C1
Solution 3: A5 → B3 → C2

To select the best solution we set criteria, based on which we evaluated every solution according to the defined factors of relative importance and the satisfaction level of every individual criterion. In this way we found out that in our situation the 2nd solution is the most appropriate one.

The criteria were as follows:

A. Universality
B. Production difficulty level (nr. of operations)
C. Material costs
D. Ergonomics
E. Sales price



Morphological analysis for the product: Smart phone holder

PROJECT: New product development

PRODUCT / SERVICE: Smart phone holder

PROJECT GROUP:

Solution variants / Function parameters	1	2	3	4	5	6
A. Makes mounting of the holder on the handlebar possible	Fixation with two strings	Flextigt system on both sides of the handlebar	Jaws with Q/R Bracket screw	Cup for final fixation added	Direct fixation on top of the front fork	
B. Makes clamping of the holder possible	Suction cup	Movable jaws with springs	Plastic holder with locking mechanism			
C. Makes rotation of the holder possible	Manually with clamp mechanism	Mechanism with cylinder and ball joint				
D. Protects from strokes and water	Small cylinder with coiled-up film					

The possible solution for D has been excluded because the need for this function has been determined on the basis of the Conjoint analysis among potential buyers.

Fig. 2. Morphological analysis [19].

6. Conjoint Analysis

In the framework of developing a new product, Value analysis is complemented by Conjoint analysis, as the latter enables us to determine which functions of the new product are regarded as the most important for potential users [9]. Conjoint analysis assumes that the utility of a product/service can be decomposed into attribute utilities and that an aggregate or individual-level utility function can be estimated with attributes as arguments [5]. Therefore, we selected some attributes of the product, which in our opinion influence the choice for buying such products:

- Method of mounting the holder on the bicycle handlebar
- Rotation level
- Protection

The survey was conducted using an online questionnaire on the Facebook social network, where we also asked the respondents to forward our questionnaire via e-mail. To create the questionnaire we have used the Fluidsurveys website and received 117 completed questionnaires obtained from random respondents. Furthermore, we handed out a couple of questionnaires in a specialised shop for bicycles and bicycle equipment and thus obtained a few more completed questionnaires. The sample included 127 potential users of the holder. We have to stress that during the course of the survey we asked the participants not to take part and fill in the questionnaire if they never cycle. In this

way, we wanted to assure that most of the survey participants are potential users who have a sufficient understanding of the product's functions.

Of the 127 survey participants 88 were male and 39 female. This means the ratio between men and women was approximately 2:1; this is a realistic ratio between male and female cyclists, especially when it comes to mountain biking or adrenaline cycling.

7. Results

For a better overview of the kind of products potential users want, we presented 8 potential concepts of the product to the participants, after they had acquainted themselves with the attributes and their levels. Afterwards the respondents ranked the product's concepts from 1 to 8, depending on which concept they liked the best (rank 1) and which they liked the least (rank 8). We processed these results with the SPSS programme, version 17.0, to determine which concept of the product the participants prefer and which attributes of the product they like.

Based on the sample we also wanted to find out whether certain demographical characteristics influence the decision or in other words if one segment of the participants prefers certain attributes of the product (Table 4). Therefore, we divided the sample into "*active cyclists*", "*occasional cyclists*", "*mountain cyclists"* and *"road cyclists".* We defined active cyclists as those who ride their bicycle every day and several times a week and use it for recreation or for everyday errands. Occasional cyclists were defined as those who use their bicycle only a few times a month or year. We classified mountain cyclist as those who stated that they are mostly engaged in »CrossCountry«, »Trail/Allmountain« and »Downhill« cycling. As road cyclists we classified all other cyclists who mostly ride their bicycle on even terrain or asphalted surfaces.

Table 4. Relative Importance of the Attributes based on to the Type of Cyclists.

	MOUNTING METHOD	PROTECTION	ROTATION LEVEL
ALL			
value	52.320	35.805	11.875
rank	1	2	3
ACTIVE CYCLISTS			
value	55.113	32.553	12.334
rank	1	2	3
OCCASIONAL CYCLISTS			
value	50.229	38.589	11.182
rank	1	2	3
MOUNTAIN CYCLISTS			
value	50.976	34.403	14.621
rank	1	2	3
ROAD CYCLISTS			
value	53.164	36.686	10.151
rank	1	2	3

Initially we anticipated that demographic characteristics, based on which we have classified the survey participants, would influence the importance of attributes; however, the values of each attribute are very similar in different groups. In general, the attribute *mounting method* was ranked as the most important one by the

respondents, followed by the attribute *protection*, the attribute *rotation level* was considered as the least important one.

Furthermore, the classification based on the frequency of cycling is of importance, as "active cyclists" are more likely to buy our product. We noticed that potential users strongly prefer a mounting method which enables the holder to be taken down and this holds true for all demographic groups. For the other two attributes there is no visible preference between the values. Very interesting is also the fact that for active cyclists phone protection is less important than for occasional cyclists. A reason for this may be the fact that occasional cyclists took the survey less seriously, as they have no intention of using such products and therefore ignored the added price and evaluated the concept only according to their "fondness" for the product.

We added this classification because we are of the opinion that our product is more suitable for uneven terrain. We found out that especially road cyclists prefer the possibility to remove the holder mounting device. One of the reasons could be the fact that in this group of cyclists we also included those who mostly use their bicycles in the city, where it is advisable to take off a product like ours from the handlebar in order to protect it from theft. For us, the information that the preference for the value "protective film" was increased among mountain cyclists compared to the whole sample is very valuable, even though the difference is not that big. This result is very important for us, as we are of the opinion that our product is slightly more appropriate for mountain cyclists and therefore we would prefer to satisfy the needs of this group.

In comparison to other categories, we noticed a slight increase of preference for the value "rotation B" in the category of mountain cyclists; a reason for this can be that this concept solution is more simple and robust. Nevertheless, we were very surprised by the fact that irrespective of the type of cyclists, the majority of the respondents would not choose the protective film; a possible reason for this could be the fact that no good pictorial representation for this attribute was included in the questionnaire, as we were concerned that with a better representation of the solution we would disclose too much details about the new product.

With the help of the value analysis and the QFD and Conjoint method, we were able to develop a final version of the product (Fig. 3). Based on the results of the analysis, this is the most pleasing version for us and for all potential customers which in our opinion also has the best chances to be sold, if put on market.

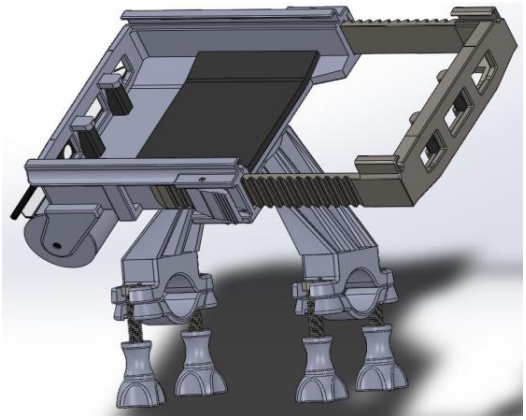


Fig. 3. Concept of the developed product.

8. Conclusion

Based on the results, we can conclude that an objectively determined value of a product plays a vital role if we want to make a product truly interesting for a customer or the user and if we want to fulfil his/her expectations. But perhaps it is even more important that by implementing such methods costs inside a company are strongly reduced or, as in our case of a non-existent company with no production capacities yet established, it is possible to determine which functions of a product must be emphasised and which should be disregarded or even abandoned.

As stated by many authors, approximately only one in every four products becomes successful in the market. But

of course each new product must be tested before entering a market in order to approve its compliance with standards and safety regulations. As regards our product, this would be the next essential step if we want to start mass production. The feedback information we received from potential users about the product's concept strengthens our endeavours, because the respondents have confirmed its enormous potential and because they were truly involved and have contributed greatly in developing the final image of the product. Moreover, they have also expressed great interest and a desire to buy the product. However, how successful a product will be on the market does not only depend on its quality and successful marketing but also on unexpected changes on the market which must be predicted.

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