

# Marketing aspect in the ‘Value Engineering’ in the new products development of machine-building enterprises

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**Abstract.** The dynamism of the engineering products markets is determined by a high level of competition, frequent changes in technology. One of the key problems of Russian machine-building enterprises is the long term of development and putting the product into the production which leads to the fact that ‘yesterday's product is launched on tomorrow's markets’. So, we see an arising need for a fundamental change in the product development process by including future consumers in it and ensuring verification of the results at each stage, from the formation of the technical task to the testing of the finished product. Such an approach will allow balancing consumer value and product characteristics, determining the significance and cost of functions, and substantiating a fair price. These problems are solved by the method of value engineering of a product. Application of this method requires reliable information on consumer characteristics, conditions and process of product operation, parameters of similar products. The tools of classical marketing research and new products engineering development should be combined into one system. As a result, the use of value engineering reduces the time required to bring a new product to the market and increases the competitiveness of the product.

## 1. Introduction

The activity diversification and the new products development become an important area of a machine-building enterprise adaptation in the market in a constantly changing economic environment. The dynamism of industrial markets, high competition and continuously improving production technologies force many companies to seek and use methods reducing the time taking to develop and launch new products on the market. A long period of development and putting the product into production leads to the fact that ‘yesterday's product is launched on tomorrow's markets’. Competitors quickly adopt other's decisions and develop new ideas; therefore, innovative activity at the enterprise should be a continuous and systematic process. Interaction with potential customers in the process of product development and continuous verification of the results are crucial in ensuring the competitiveness of the product [1, 2]. The reduction of production costs and the ensuring of the product target cost is another serious task. How one can create a product with the characteristics that meet all the requirements of potential consumers, and ensure the level of costs corresponding to the price that the buyer is willing to pay, in a short period of time?

## 2. Parameters that determine the engineering products competitiveness

The competitiveness of the product on the market is determined by two groups of indicators that reflect the ratio of ‘price-quality’ [3, 4]:



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- Consumer properties of the goods (quality), constituting value to the consumer. These properties are determined by a set of ‘hard’ and ‘soft’ consumer parameters.
- Economic properties of the goods (price). This group includes the selling price, total costs of transportation, installation, maintenance, operation, repair, taxes, insurance and disposal.

When conducting market research, it is necessary to determine the consumer properties of the product that make up its value. ‘Hard’ parameters describe the most important functions of the product and the associated characteristics that determine its range of application, ergonomic indicators that characterize ease of use for a person, technical indicators that characterize technological solutions, reliability, and safety. The second group of ‘hard’ parameters includes technical ones, as well as the parameters of compliance with national and international standards, norms, legislative acts, etc. ‘Hard’ parameters provide the ability to use the product for its intended purpose [5].

‘Soft’ parameters characterize the aesthetic properties of the product, that is are an expression of design, packaging, color. The second group of ‘soft’ parameters is psychological ones that determine prestige, attractiveness, accessibility and so on. ‘Soft’ parameters, as a rule, do not have a natural physical measure and are difficult to quantify [6].

When conducting value engineering, it is necessary to study the requirements for an engineering product from consumers, service and repair organizations that carry out its maintenance. The significance of these studies is emphasized by many authors of scientific publications [7–9]. This means that preliminary marketing research should provide information on the conditions of operation and maintenance of the object, customer requirements and target technical characteristics of the product. The author’s approach consists in applying the target focus groups survey method, the purpose of which is the formation of an initial data set necessary for the value engineering of a high-tech product.

### **3. Value engineering method**

Value Engineering (VE) method is used to design the value of a product at the stage of its development [10]. VE is a part of the Value Analysis (VA). Value Analysis method contributes to the solution of such critical tasks as [11]:

- reducing the duration of the product development (modernization) and development of the product manufacturing;
- creation of high technical level products, competitive in the foreign market and satisfying the needs of consumers;
- ensuring the stability of functionally necessary quality (required consumer properties) of the product during its development, manufacture, storage, transportation, consumption and disposal;
- ensuring efficient operation;
- bringing the costs of product development, its manufacture, use and consumption to the level required by the end user.

Thus, the use of value engineering is possible both in the development of a new product and in its redesign in order to increase the value of the product while reducing costs [12]. VE allows us to consider the designed product as a set of functions that it should perform, creating value for the consumer. The functions of the object should reflect the content of the action or process for which it or its components are intended [13]. Simultaneously with the formulation of the required functions, constructive options for their implementation are proposed, and a feasibility study of these options is carried out. The results of this work are presented in the form of a matrix of functions containing their assessment, or in the form of a functional model.

The content of the work at various stages of the VE is shown in table 1 (compiled by the authors based on the source [11] and their own results obtained in the course of the VE project at one of the machine-building enterprises of the Ural Federal District).

**Table 1.** Work content at the stages of the Value Engineering.

Stages	WorkContent
<i>Information</i>	<ul style="list-style-type: none"> <li>• determination of consumer requirements for the product;</li> <li>• determination of the servicing and performing repairs specialists requirements to maintainability and ease of maintenance of the designed product;</li> <li>• determination of the product main technical characteristics;</li> <li>• description of operating conditions;</li> <li>• study of the operating conditions influence on the product main technical characteristics;</li> <li>• setting quantitative technical and economic goals;</li> <li>• determination of the base (analogue) for the study;</li> <li>• description of the functional composition of the product (analogue) original design;</li> <li>• designing a structural element model of an analogue.</li> </ul>
<i>Basic</i>	<ul style="list-style-type: none"> <li>• formulation of the designed object functions and classification of functions;</li> <li>• development of the functions implementation concept scheme;</li> <li>• formation of a functional model;</li> <li>• determination of the constituent parts of the designed object (correspondence matrix);</li> <li>• definition and analysis of the performing functions costs;</li> <li>• expert evaluation of the product functions significance;</li> <li>• assessment of the product manufacturing laboriousness;</li> <li>• cost evaluation of the product production and the facility operation, the product disposal.</li> </ul>
<i>Analytical</i>	<ul style="list-style-type: none"> <li>• determination of the basic set of functions (basic configuration of the designed product);</li> <li>• determination of the optional set of functions (optional configuration);</li> <li>• comparison of the functions significance and their implementation costs;</li> <li>• separation of costs into functionally necessary and excessive;</li> <li>• the allocation of structural-element or functional areas with the highest concentration of costs for materials, purchased components and labor.</li> </ul>
<i>Creative</i>	<ul style="list-style-type: none"> <li>• identification of the 'narrow' ('weak') places in the design, technology, materials;</li> <li>• search for ideas and preparation of proposals for improving the product;</li> <li>• formation of product concepts (implementation of the same function by various design solutions);</li> <li>• elimination of discrepancies in significance and costs identified at the analytical stage;</li> <li>• elaboration of advanced alternates and selection of the most appropriate options.</li> </ul>
<i>Research</i>	<ul style="list-style-type: none"> <li>• development of sketches for selected options;</li> <li>• comparative technical and economic assessment of options;</li> <li>• examination of selected solutions and options' evaluations.</li> </ul>
<i>Recommendation</i>	<ul style="list-style-type: none"> <li>• selection of the most rational solutions for implementation.</li> </ul>

#### 4. Structure of typical marketing research reports

Standard marketing research carried out by machine-building enterprises, as a rule, does not give an idea of the 'functional appearance' of an object, which greatly complicates the implementation of value engineering and increases the time for product development. Therefore, the marketing aspect will play a decisive role in creating the best product for the client at minimal cost at the stage of product development.

Marketing research can be divided into three key types that determine the structure of a marketing report: market research, consumer research and product research. Market research allows us to determine the state of the market. Consumer research allows us to determine the full range of factors that consumers are guided by when choosing a product. The study of the product allows us to get the most valuable information about the consumer properties of the product and data for the formation of a successful advertising campaign from the buyer's point of view [14]. The first type allows us to make

a decision on the choice of a new product for production. It is necessary to concentrate on the last two types for the purposes of designing the value of a product and its consumer properties.

The contents of the typical marketing reports offered by many marketing companies can be summarized in the form of the following main blocks:

- market conditions;
- manufacturers;
- buyers;
- product characteristics;
- prices;
- suppliers (distribution);
- leasing companies;
- customs regulation;
- government regulation and support;
- tenders;
- possible risks;
- factors influencing market development;
- forecast for the development of the market for the investigated products.

The information presented allows us to characterize the market, to determine the main areas of activity, to find out unoccupied or under-occupied niches in the market, to develop our own assortment of goods or services in accordance with the requirements of customers and the existing competition, to draw conclusions about the production prospects of the products under study, to formulate recommendations for choosing a strategy for this market. For the purposes of developing new competitive products, the main goal of marketing research will be to determine the properties of the product that it must possess in order to meet the needs of potential users [15]. For this, it is necessary to establish constant interaction with the target focus group, consisting of specialists in patent analysis, potential consumers of products, specialists in repair and maintenance services, suppliers (distributors) of products.

### **5. The focus group survey method in order to conduct VE**

The result of this marketing research instrument is a list of new product target parameters for the further establishment of a fair competitive price and calculation of target cost. Below are the market study results of certain types of warehouse lifting equipment, conducted by the authors of the article in 2019. To achieve this goal, the following tasks were solved:

1. The focus group composition of various stakeholder groups' representatives was formed. The focus group included dealers and warehouse equipment service organizations in addition to direct consumers in accordance with the objectives of the study. The composition of the focus group is as follows:

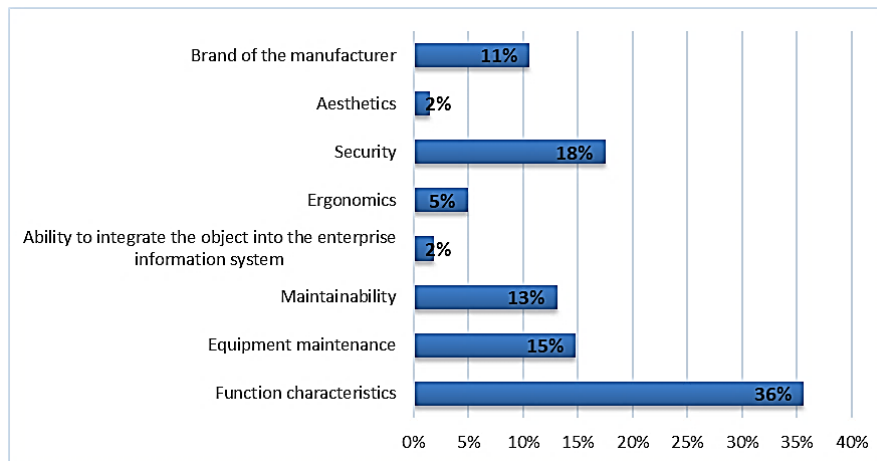
- 12% – warehouse facilities;
- 50% – distribution centers;
- 25% – logistics companies;
- 13% – dealers and service organizations.

2. A focus group survey was conducted using questioning and interview methods. The objectives of the survey were:

- determining the operating conditions of the facility (that is the type and area of the warehouse, the nature of the cargo, the organization of warehouse logistics, the level of automation, etc., in this case);
- importance assessment of the parameters that affect the equipment type and model choice in such categories as function characteristics (technical parameters); equipment maintenance; maintainability; the ability to integrate the object into the enterprise information system; ergonomics; security; aesthetics; brand of the manufacturer (Figure 1);

– obtaining expert opinions on the necessary characteristics of the product basic model, as well as the selection of those parameters that will be optional, increasing consumer properties and the price of the product.

A total of 73 parameters were allocated for the formation of the designed product configuration in groups: safety, ergonomics, ability to integrate into the warehouse information system, maintainability and maintenance of equipment. Of these, 39 parameters (53%) were included in the basic configuration of the product and 34 parameters (47%) were included in the optional configuration. All function characteristics were included in the basic configuration of the product.

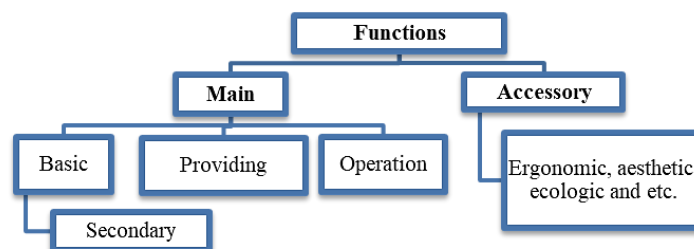


**Figure 1.** The significance of consumer product parameters.

3. The data obtained were processed and a conclusion was generated. The conclusion contains the following results:

- the scope of the equipment operating conditions was defined (the consumer profile was specified) and the choice of the closest analogue (group of analogues) was substantiated;
- the coefficients of the product parameters significance were calculated, including those related to the basic version and optional solutions;
- a comparison of a new product with an analogue was made, the coefficients of compliance by the compared parameters were calculated.

Based on the results obtained, a modernized classification of product functions was proposed (Figure 2), which was subsequently used in the value engineering of warehouse lifting equipment.



**Figure 2.** Author's classification of the product functions.

Thus, the addition of a special survey of the target focus group to the marketing research allowed the authors to improve the existing classification of functions. In particular, the management functions of a technically complex product were identified, due to the need to integrate the object into the logistics ecosystem. The implementation of the proposed approach made it possible to design a functional model of the product, as well as to propose a concept that defines the basic configuration (basic set of functional characteristics) and options (additional set of functional characteristics) of a future product.

## 6. Conclusion

Companies operating in dynamic markets, characterized by changing economic conditions, development of technology, increasing competition, should have flexible competencies that allow them to quickly develop products that meet today's market requirements and are even ahead of them. The method of value engineering combined with target focus groups' marketing research will allow companies to reduce the development time of a new product, ensuring its competitiveness and balance of costs, price and profit. However, an individual approach to the formation of the focus group and the description of the product functions is required in each case.

The focus group should include representatives of all stakeholder groups that determine the value of the product. The separation of product functions into basic and optional plays an important role in conditions of customer-oriented production, as it will affect the target cost of the product. Machine-building enterprises, as a rule, produce technically sophisticated products combining functions of human management and software. In this case, management functions that ensure the integration of the facility into the enterprise management system are of particular importance. The use of focus groups' marketing research allows us to solve the above problems and to prepare the necessary information support for the value engineering of the product.

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