

Value Analysis of the Machine-Building Enterprise Repair Facilities Activities

Tatyana A. Mineeva^{1,*}, Nadezhda A. Kuznetsova¹, and Nataliia E. Kalinina¹

¹Institute of New Materials and Technologies, Ural Federal University named after the first President of Russia B.N. Yeltsin, 620002, 19 Mira street, Ekaterinburg, Russia

Abstract. This article is devoted to the problems of the organizational structure optimization by the method of Value Analysis (VA). The analysis of the control system is of particular relevance in modern conditions. The purpose of this article is to adapt the Value Analysis to the management structure with the possibility of increasing efficiency. VA is a universal and highly effective method for optimizing parameters and other design, technological, organizational, economic characteristics of products, works and services. The hypothesis of the possibility of applying the Value Analysis to the organization of the enterprise subdivision work is considered. The article examines the VA tools using the example of an enterprise's repair service. An organizational structural-element model of the object is being built. Decomposition of functions is carried out. According to the level criterion, the functions are classified into main and auxiliary ones. The significance and functional costs are determined. A functional-cost diagram is constructed, which allows highlighting the functions with the greatest deviations that need to be improved. The VA stages are accompanied by graphical illustrations and tables which allow us to clearly demonstrate the logic of the method application to the work of the enterprise division. As a result, the optimal concept of the organization of the machine-building enterprise structural unit is formed.

1 Introduction

At present, the use of a high-quality personnel management strategy has become an important factor in the growth of the activity efficiency of industrial enterprises. Leading machine-building enterprises successfully apply Value Analysis - a method of systematic study of the object functions in order to find a balance between cost and value. The quality improvement of manufactured products is the object of research at enterprises. The use of this method is limited to technical systems: the improvement of structures, technologies for their manufacture. Value Analysis has established itself as a method for optimizing organizational structures, personnel management systems.

The relevance of the work lies in the adaptation of Value Analysis methods to assess the current organization of the subdivision. The paper describes a scheme for analyzing the

* Corresponding author: t.a.mineeva@urfu.ru

distribution of employees' functions, the conditions for the applicability of the approach, and assessing the effectiveness of the machine-building enterprises structure.

The Value Analysis of the personnel management system is a method of searching for reserves to increase the efficiency of the enterprise personnel management system functioning by dividing personnel costs according to the main functions of human resource management. [1, 2] Based on the Value Analysis principles, the organization's personnel management system is a continuous process of improving the principles and methods of working with the personnel of the enterprise, the main goal of which is to create conditions for the most effective use of them. [3]

Let us consider the method of Value Analysis for the management system analysis, taking as a hypothesis that it can be an effective approach to the management structure assessing.

Most of the researchers [4-6] present the process of Value Analysis application to organizational and management systems as a sequence of stages typical to the methodology of this method: preparatory, informational, analytical, creative, implementation stage. Research and recommendation stages, which correspond to a greater extent to technical systems, are considered less often.

The content of the stages has certain specific features:

- the structural-element model represents the organizational-structural diagram of the enterprise (department), reflects the linear and functional relationships between the elements;
- the functional model reflects the relationship between the employees of the enterprise and the functions they perform: main, basic, auxiliary;
- the identification of the basic and auxiliary functions is carried out through the decomposition of the functions higher in the hierarchy;
- an important role is played by auxiliary functions as a carrier of internal problems of an enterprise (department), a source of identifying internal reserves;
- determination of the significance and costs of functions, construction of functional-cost diagrams;
- identification of the zone of the costs highest concentration as the most promising zone for further analysis;
- improvement of the management system through the construction of the most optimal relationships, allowing to reduce costs, redistribute the workload between employees;
- analysis of the new structure in terms of significance and costs;
- comparison of the current management structure and the projected management structure;
- determination of the new management structure performance indicators.

The Value Analysis method makes it possible to identify the main shortcomings in the system and technology of personnel management, create a project aimed at eliminating them and successfully implement it in the activities of the organization. [3]

Efficiency indicators of the management structure are quantitative or qualitative characteristics that describe the specifics of the management process and its result. Such indicators can be:

- reducing the cost of functions in the management structure,
- increasing labor productivity,
- achieving optimal workload for employees,
- increase in production output,
- increase in profits,
- increasing the moral satisfaction of employees,
- reduction of staff turnover,
- reduction of equipment downtime.

In general, it can be concluded that the application of the Value Analysis method is aimed primarily at optimizing the costs of enterprise personnel management, which should have a positive effect on the growth of the enterprise efficiency as a whole. [7]

One of the main Value Analysis principles is the functional approach; therefore this method is effective in the field of management systems organizing. Functions define:

- structure and content of the management system;
- distribution of rights and powers of individual bodies;
- responsibility of officials.

The use of Value Analysis allows a machine-building enterprise (a division within an enterprise) to understand better the processes occurring within it, to assess the costs incurred.

Value Analysis is not only a method of analysis that allows us to identify reserves and shortcomings, but also a method of substantiating and developing measures to improve the management system, a method of implementing organizational measures. [8-10]

2 Materials and methods

The methodological basis for the study of the assigned tasks solution, determined by the purpose of the work, is a systematic, methodical approach to assessing the management structure of a machine-building enterprise, functional-cost analysis and structural-logical analysis.

The advantages of Value Analysis use are a functional approach in combination with modern methods of enhancing creative thinking and searching for original ideas, assessing the quality of options and the costs of providing and implementing the specified items of the object while using structural models.

Practice shows that the use of structural models does not exclude the simultaneous use of functional models. Value Analysis is located between science and production itself, forming a technical and economic base for production activities.

3 Results

The work considers the organization of the repair facilities. The reason for choosing this object of research was the downtime statistics of the leading group of equipment - technological lines. Cumulative downtime in 2016 was 900 hours; downtime associated with equipment repair - 635 hours. The existing structure is shown in Figure 1.

The following bottlenecks were identified in the analysis of production work:

- unsatisfactory organization of the function execution process " Providing the work of the department repair service with spare parts and consumables", in particular with regard to the consumption of working time resource for the implementation of this function by its carrier;
- lack of resources, in particular labor, for the implementation of the function "Preventive equipment repair."

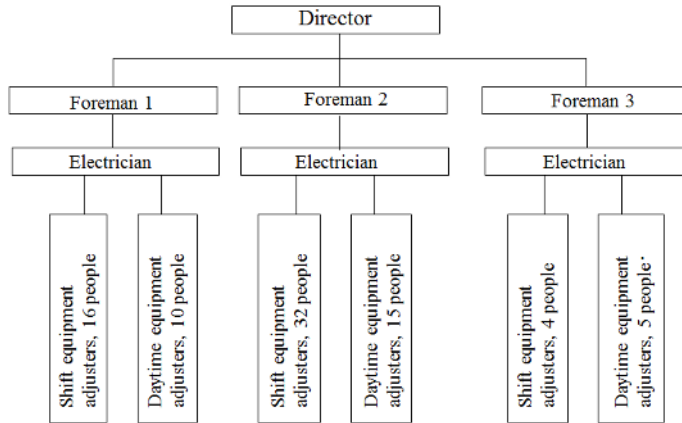


Fig. 1. Structural element scheme of production.

The classification of functions and the calculation of the costs and significance of the functions were carried out based on the constructed structural element scheme (Table 1).

Table 1. Significance and function costs

Function	Function code	Significance	Carrier	Costs
Control of equipment operation and implementation of the technological process	F1.1	0.703	Shift equipment adjusters	0.708
Adjustment of equipment operating modes	F1.2	0.297		0.292
Current maintenance of equipment	F2.1	0.424		Daytime equipment adjusters
Current equipment repair	F2.2	0.374	0.527	
Preventive equipment repair	F2.3	0.202	0.086	
Department repair service personnel management	F3.1	0.589	Electrician	0.500
Planning of work on the maintenance of technological equipment	F3.2	0.292		0.208
Providing the work of the department repair service with spare parts and consumables	F3.3	0.119		0.292

The following functions have the greatest discrepancy in terms of significance - costs: Preventive equipment repair, Current equipment repair, Providing the work of the department repair service with spare parts and consumables. Moreover, functions F3.3 and F2.2 are skewed towards costs, while functions F2.3 are skewed towards significance. The functional-cost diagram of the functions current state is shown in Figure 2.

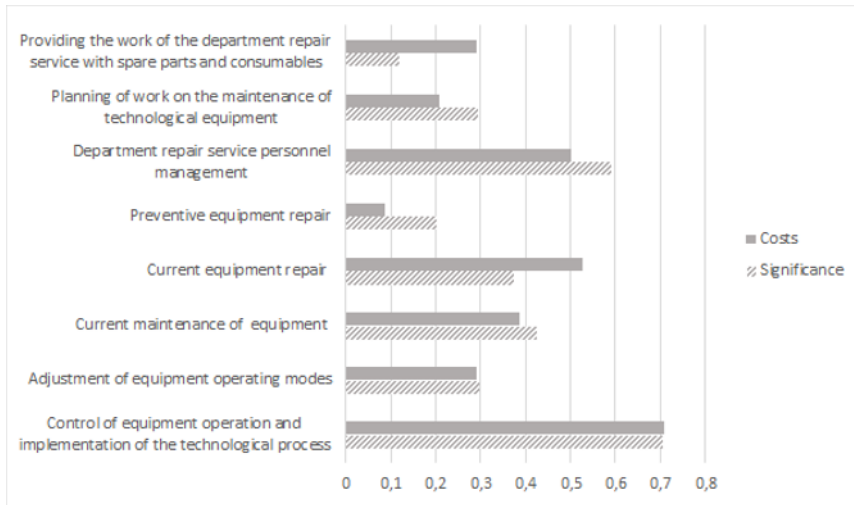


Fig. 2. Functional-cost diagram of the functions current state.

A redistribution of functions between carriers and the allocation of a common responsibility center for the entire production are proposed based on the classification of methods for the implementation of functions and the methodology of morphological analysis.

Figure 3 shows the proposed management structure. A production preparation engineer appears on the projected scheme at the level of shop managers. Electricians (2 people) are subordinated to him, forming a new center of responsibility. The shift and daytime equipment adjusters are subordinated to the foremen. The function "Providing the work of the department repair service with spare parts and consumables" will be performed by the introduced position. Changes in the significance and costs are shown in Table 2 and Figure 4.

As a result, the work of the repair service is optimized according to the parameters of significance - costs: reducing the workload of electricians by functions not typical for their activities by 30%; reduction of downtime associated with equipment repairs by 65% in the total number of downtime.

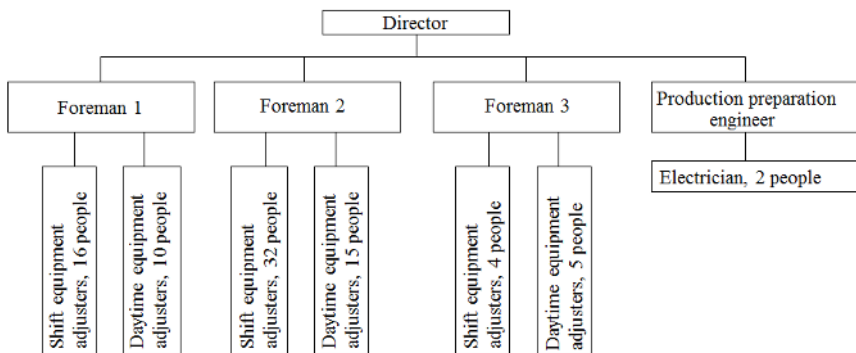


Fig. 3. Projected management structure.

Table 2. Significance and function costs in the projected variant

Function	Function code	Significance	Carrier	Costs
Control of equipment operation and implementation of the technological process	F1.1	0.703	Shift equipment adjusters	0.708
Adjustment of equipment operating modes	F1.2	0.297		0.292
Current maintenance of equipment	F2.1	0.424	Daytime equipment adjusters	0.387
Current equipment repair	F2.2	0.374		0.527
Preventive equipment repair	F2.3	0.202		0.086
Organization of storage and accounting of spare parts and consumables for equipment repair and maintenance	F3.1	0.389	Electrician	0.390
Planning of work on the maintenance of technological equipment	F3.2	0.611		0.610
Providing the work of the department repair service with spare parts and consumables	F3.3	0.725	Production preparation engineer	0.710
Department repair service personnel management	F3.4	0.275		0.290

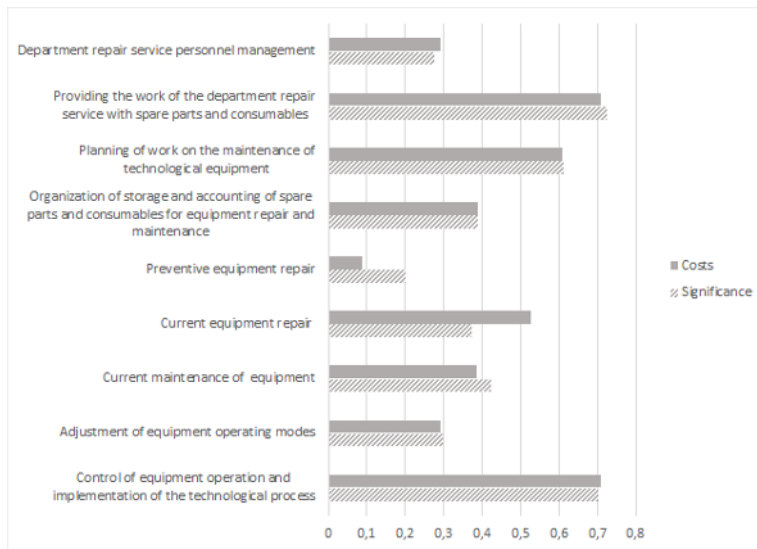


Fig. 4. Functional-cost diagram in the projected variant.

4 Discussion

The purpose of this study is the Value Analysis adaptation to the management structure optimization. The hypothesis is considered: the comprehensive application of the Value Analysis to the optimization of the management structure. Let's formulate the main Value Analysis work stages of these processes. Below are the stages.

1. An organizational structure is being built with the distribution of functions among the employees of the enterprise. In the terminology of the Value Analysis, it is a structural-element model. The decomposition of functions must be done to the level of tasks performed by employees of the enterprise, which can be assessed in terms of significance and costs.

2. The assigned functions are classified into main and auxiliary according to their level. For example, the first level of decomposition is basic, the second is auxiliary.

3. The significance, duration of implementation and costs are determined for the selected functions.

4. Further, the functions for improvement are highlighted. Improvement variants are developed and the duration-cost-per-function relationship is re-analyzed. New variants are being developed using morphological analysis. It allows obtaining a set of theoretically possible options for implementing an object with the required functions using combinatorics.

External functions characterize the relationship of the enterprise with the external environment; internal functions characterize links between departments and within the department, its components, due to the principles of building the structure.

Main function characterizes the main purpose of the unit, determines the principle of operation.

Basic functions contribute to the implementation of the main and secondary functions, and the auxiliary ones contribute to the implementation of the basic ones.

It is necessary to determine the type of functions, as well as to find the most problematic function, the change or removal of which will give the most optimal structure of the system under study (maintaining quality while reducing costs) in the considered management system.

An important element is to determine the significance of functions, to compare the significance and costs of a function when conducting functional-cost analysis of a management system. The significance of functions is a special criterion for determining the importance of the functions of a position / unit.

The comparison of significance and costs per function is reflected in the functional-cost diagram, which allows drawing conclusions on the deviations between these indicators. These deviations are called the point of mismatch in Value Analysis. They are a guideline for finding problematic functions - functions in which costs exceed significance. These functions should be subject to improvement.

5 Conclusion

The new concept of the management system optimizes the value-cost ratio for all problematic functions. Costs outweigh the significance in three functions. It is proposed to introduce a new center of responsibility - a production preparation engineer, who will implement the function "Providing the work of the department repair service with spare parts and consumables". As a result, the indicators will be aligned.

Thus, the Value Analysis method makes it possible to identify problematic, painful functions (points) of the unit's work, thanks to the construction of a functional-cost diagram. The method not only reduces costs, but also optimizes the ratio: significance - costs. It allows you to create a new concept of a management system that is more efficient. We can say that the Value Analysis increases the efficiency of the department.

References

1. Ya.I. Vishnevskaya, *Theoretical foundations of functional-cost analysis in personnel management*, Alley of Science, **5 (21)**, pp 767-771 (2018)
2. A.V. Dzhiyev, L.K. Gurieva, A.V. Kamalov, *Development methods of the intellectual capital organizational component of the company*, Humanities and socio-economic sciences, **2 (105)**, pp. 142-145 (2019)

3. O.A. Dinukova, *Value Analysis in the personnel management system*, In the collection: Russian science: current research and development. Collection of scientific articles of the VIII All-Russian scientific-practical conference, pp. 146-148 (2019)
4. O.A. Dinukova, *Value Analysis in the personnel management system*, Economics and Entrepreneurship, **8 (121)**, pp. 1293-1296 (2020)
5. I.N. Makhmudova, N.D. Saraeva, *Methodical approach to the use of functional-cost analysis in the personnel management system*, Eurasian Union of Scientists, **31-3**, pp. 92-98 (2016)
6. E.A. Rezanovich, *Practical application of Value Analysis in the personnel management system*, Modern problems of science and education, **6**, pp. 4-27 (2014)
7. Yu.Yu. Velnicher, *Structural elements and stages of implementation of the project for improving systems and technologies of personnel management, developed on the basis of functional-cost analysis*, In the collection: Modern scientific research: Theory, methodology, Practice. Collection of articles based on the materials of the II - International Scientific and Practical Conference, pp. 111-116 (2020)
8. E.V. Borisova, *Value Analysis as a method of searching for reserves to reduce production costs*, Economic security bulletin, **3**, pp. 193–197 (2017)
9. K.V. Fedina, *Application of functional-cost analysis in the personnel management system*, Economics and management of innovative technologies, **12 (75)**, pp. 12-14 (2017)
10. A.V. Scherbakov, *Value Analysis for business planning purposes*, Bulletin of Tver State University. series: Economics and Management, **1**, pp. 28-33 (2019)