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To cite this article: T A Mineeva *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **971** 052015

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Improve business process efficiency by value engineering

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Abstract. This article is devoted to the problems of business processes optimization by value engineering (FCA) method. The business processes analysis is particularly relevant in modern conditions. The purpose the investigation is to adapt the value engineering to the business process. The FCA is a universal and highly efficient method of parameters optimization and other structural, technological, organizational, economic characteristics of a product, work or services. The hypothesis of the applying a value engineering to a business process possibility is considered. The article discusses FCA tools as an example of a metal rolling business delivery process. A business process model is being constructed as an object structural element model. The functions decomposition is carried out. Functions are classified into basic and auxiliary on the basis of the level. In the article the significance and functional costs are determined. A functional-cost diagram is constructed to identify the functions with the most deviations needing improvement. The FCA stages are accompanied by graphical illustrations, tables that illustrate the logic of applying the method to the business process. As a result, an optimal business-process concept with the lowest cost is being developed.

1. Introduction

At modern machine-building enterprises, the requirements for the solutions choice (to assess the optimization of business processes) are changing. The basic factors for an enterprise are the personnel activity formalization degree and the laboriousness of the proposed solutions implementation. Low levels of digitization and staff resistance to change are additional constraints that block the process approach development.

The work relevance is in the value engineering adaptation to the current business processes assess. The paper describes a business process analysis scheme, the approach applicability conditions, and the machine-building enterprises processes efficiency evaluation.

A business process is a set of works and/or services that together produce a result that becomes a value to the enterprise and/or the client. For each process, the following elements are distinguished: input (elements that are transformed during the actions execution), output (obtained result), resources / mechanisms (elements that ensure the actions execution), the process owner (manager or coordinator of the process).

Most of the researchers [1,2,3,4,5,6,7,8] offer to analyze business processes based on modeling methods. It is understood that in the formalization process an expert either «sees and understands» errors (the business process problems) or the constructed diagrams allow to track break points and the business process logic violations. This approach is highly dependent on the expert's skill level and does not guarantee an increase in efficiency.



Another direction of assessment is the selection and analysis of indicators [9, 10,11,12,13], which are necessary to obtain information about its work and the appropriate management decisions adoption. Process indicators are a list of quantitative or qualitative parameters describing the process and its result (output). Examples of indicators are:

- the business process costs,
- the business process implementation time calculation,
- the business process results quality.

Indicators can be selected based on the subject area or the process implementation specifics in order to control its effectiveness. The effectiveness of the process is assessed as the correlation between the process goal obtaining and the goal costs of achieving. This approach does not allow an assessment based on 1-2 cycles of the process. It is necessary to accumulate statistics.

Consider the value engineering method for the business processes analyzing, accepting as a hypothesis that it can be an effective direction in the business processes evaluating.

Value engineering has established itself as an effective method for the technical systems improving. It is actively used in creating concepts to reduce the costs and improve the quality of the structures and technologies. It is a techno-economic engineering analysis method aimed at increasing or maintaining the functional usefulness of an object and the development and operation cost minimizing.

The essence of this method is the consideration of the object not in its concrete form, but as a set of functions that it should perform. Each of them is analyzed according to the possible principles and methods of execution through a set of special techniques. An object constructing options evaluation is carried out according to a criterion that takes into account the implementation degree and the functions significance, as well as the costs associated with it implementation.

The main purpose of the analysis is to reduce the production, work, services costs while improving or maintaining the quality of the work performed. This is particularly relevant in the current unstable economy [11].

In classical theory, the method of value engineering identifies the concepts: object, function, functional structure. During the objects defining, the business process is either not allocated, or its allocation does not have further consideration.

A special place in the value engineering analysis is occupied by the models concept as an object simplified representation. The models concepts are created using various description methods. In the common situation the following models are used: structural and element, functional, functional and structural models. Not all models are relevant for business processes.

For the structures or products analysis a correspondence between a structural element and a function is established. For the business processes the correspondence is between elements and functions.

Business process analysis considers a process element that is described by a functionality. Therefore, the functional model, its subsequent decomposition into functions of different levels, assumes special importance. The following classification can be applied to these functions: main, secondary, basic, auxiliary functions.

Thus, the functional model of the business process is crucial. This is a logical-graphical representation of the business process functions interconnections. It is achieved through functions formulation and the command chain establishment. Each function has its own index, which reflects belonging to a certain level of the functional model and serial number.

The top-level functions should reflect the objectives for the lower-level functions. The lower level functions are the means of the higher stage functions providing. Functions should not duplicate each other. The decomposition of functions must be done to the tasks level that can be assessed by the duration and costs. From our point of view, the functional structural model is conditional for the business process.

The function concept changes its meaning. In classical theory, a function is a qualitative aspect of the consumer property. The quantitative definition of functions allows to compare the same qualitatively consumer properties and their combination - consumer values. At the same time, a function is an element of a business process.

Functional costs play an important role in the theory of functional-cost analysis. In the general case, they are defined as the sum of material, labor and indirect costs.

When determining these costs for the business process it is necessary to speak about direct connection to the concept of « function duration», which will be reflected in labor costs.

Using the functional-cost analysis, it becomes possible to search the most economical solution (for the manufacturer and consumer), as well as continuous improvement of products, services, production technologies, which is important in a competitive market [15,16].

The concept of value engineering of business processes is used in different articles. But there is no algorithm for applying of this method to business processes, as well as practical examples of its use. It is extremely important to develop a real mechanism for applying value engineering to the business processes.

2. Materials and methods

The methodological basis for the investigation are the systematic, methodical approach to the assessing of the machine-building enterprise business processes, functional cost and structural-logical analysis.

The advantages of the value engineering using are a functional approach combined with modern methods of activating creative thinking and searching for original ideas, assessing the options quality and the production costs and using the process models.

Practice shows that the process models does not exclude the simultaneous use of the functional models. The FCA is located between science and production itself, forming the technical and economic basis for productive activities.

3. Results

The business process of delivery of metal rolling is considered in the work (Figure 1). The process is conducted in five stages. The stage of the transportation cost determining consists of sending inquiries by e-mail and processing responses. Searching for a contractor can take anywhere from 5 minutes to several days, which directly affects one of the service quality factors - product delivery time. The package of documents has a standard form in which the driver's personal data and the document number are entering. The control of delivery in the warehouse is complete, but outside the territory, except for the driver's cellular communication, the logistic has no confirmation. Document management should consist of attaching correctly filled documents and keeping them in an archive

However, due to the driver's inattention or haste, about 60 % of the documents are filled with errors. The sales manager must deal with their refilling.

There are problems in the business process

- the client requests a refund on the basis of the production lack,
- re-signing of documents takes extra time, or documents remain incorrectly completed.

Based on the constructed model of the business process, the functions were classified and the costs and significance of the functions were calculated (table 1).

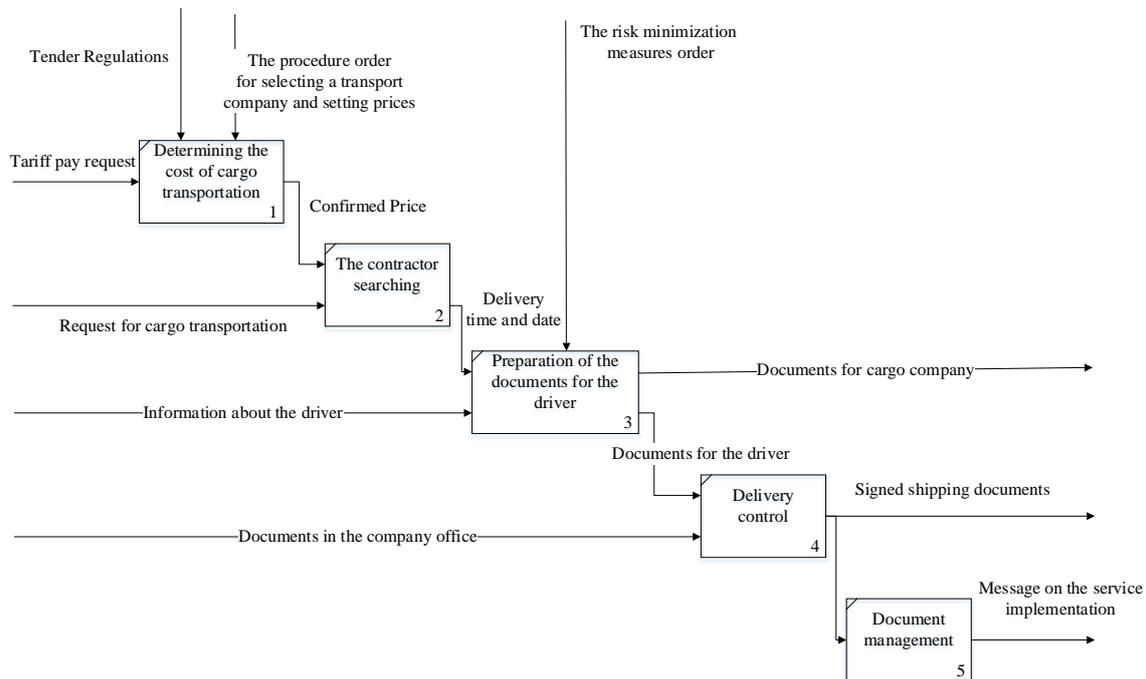


Figure 1. Decomposition of the first level of the process «Metal rolling delivery».

Table 1. The significance and costs of functions.

Function	Function code	Significance	Min. working time, min	Max. working time, min.	Salary, rub/month	f costs, rub.
Determining the cargo transportation cost	F1	0.1	5	90		178.00
Contractor searching	F2	0.4	5	300		556.00
Preparation of the documents for the driver	F3	0.1		30	35 000.00	110.00
Delivery control	F4	0.25	20	45		119.00
Document management	F5	0.15	20	120		255.00
Total		1	80	465		1 213.00

The largest percentage in costs is accounted for the cargo carriage contractor search function - 46%. Then the document management function is almost 21%, it important that only the time of scanning and attaching documents to the corporate program is taken into account. In fact, 62% of returned documents from transport companies were re-signed. In third place in terms of costs is the function of the cargo transportation cost determining - 14%.

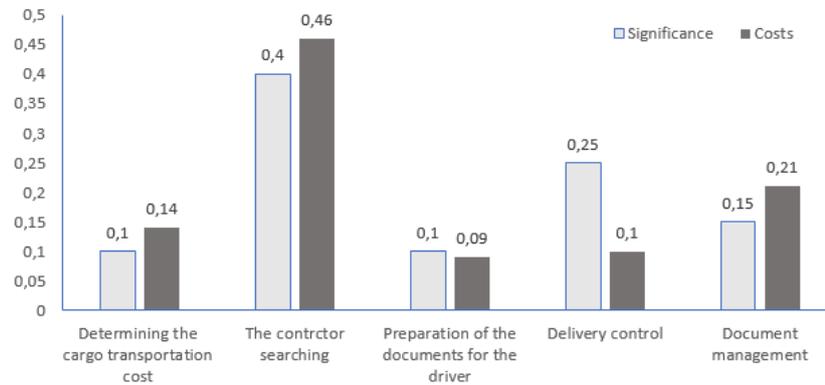


Figure 2. Functional-cost diagram of the current process.

It was proposed to change the technology for filling out the documents and to employ drivers with their own vehicles. The changed costs are presented in table 2.

Table 2. Costs changes on logistic functions.

Function	Function code	Costs, rub		
		Current	Project	Changes (+/-)
Determining the cargo transportation cost	F1	173.00	18.00	-155.00
Contractor searching	F2	556.00	0.00	-556.00
Preparation of the documents for the driver	F3	109.00	18.00	-91.00
Delivery control	F4	119.00	55.00	-64.00
Document management	F5	255.00	73.00	-182.00
Total		1 212.00	164.00	-1 048.00

The new functional-cost diagram is shown in figure 3.

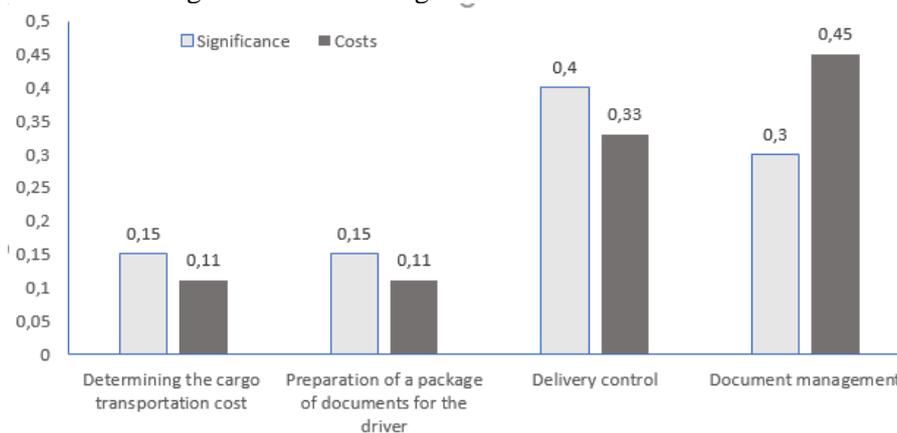


Figure 3. Functional-cost diagram of a new process

4. Discussion

The purpose of this research is to adapt value engineering to the business processes. Hypothesis considered is full application of FCA to business processes. We formulate the main stages of the value engineering of these processes:

1. A business process model is being built. According to the terminology of the FCA, it is a structural element model. The decomposition of functions must be done to the level of tasks that can be assessed by the duration and cost.
 2. Business process functions are classified into basic and auxiliary functions on the basis of level. For example, the first level of decomposition is basic, the second level is auxiliary.
 3. For the functions the significance, duration and costs are determined
 4. Then functions for improvement are identified. Improvement variants are being developed and a re-analysis of the correlation between duration and costs of the function is carried out.
- The following function classification is useful for decomposing the functions of a business process. It is used in the classical theory of functional-cost analysis. (Figure 4)

Classification characteristics	Functions
1. Area of definition	External (general object) Internal (inside object)
2. Role in needs satisfaction	main secondary basic auxiliary
3. Role in the working capacity ensuring	
4. The utility degree	Useful Useless Harmful

Figure 4. Classification of FCA functions.

External functions characterize the relation of the business process to the external environment; internal functions are the links within the process, its components, due to the principles of the process.

The main function characterizes the basic purpose of the business process, determines the principle of operation.

The main functions contribute to the implementation of main and secondary functions, but auxiliary functions contribute to the implementation of the main.

In the business process under consideration, it is necessary to determine the type of functions, to find the most problematic function, which changing or deleting will provides the most optimal structure of the business process (maintaining quality and reducing costs at the same time).

The functional model is presented on the figure 5.

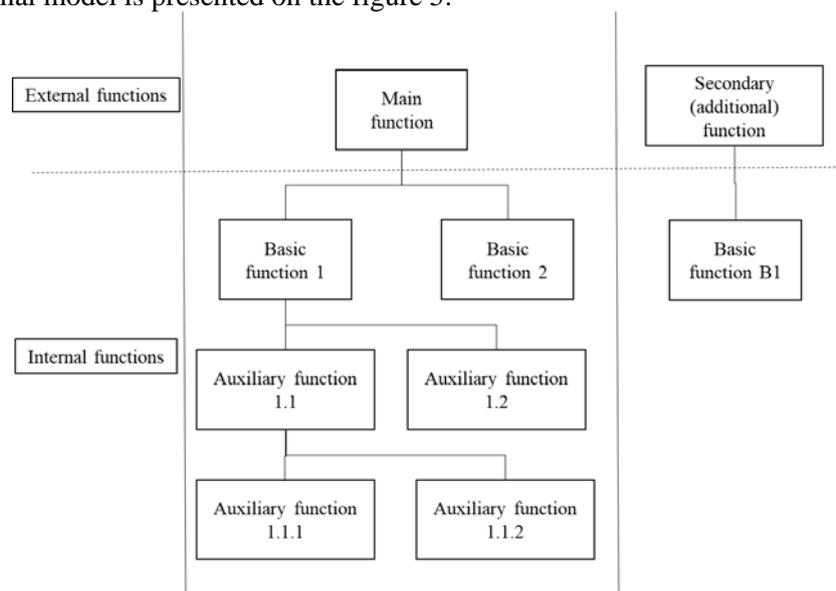


Figure 5. Functional model of an object (business process).

The number of levels in the functional model of the business process should not exceed 3-4. More levels are not rational.

The important elements in the business process function-cost analysis are the functions significance definition, the function significance and the function costs comparison. The functions significance is a special criterion for the business process functions importance determining.

The comparison of the significance and costs of the function is reflected in the functional-cost diagram, which allows us to make conclusions on deviations between these indicators. In the functional-cost analysis, these deviations are called the mismatch points. They are a guideline for finding problematic functions - functions in which costs exceed significance. These functions should be improved. A new concept of their implementation in the business process is being created.

5. Conclusions

The new concept of the business process optimizes the correlation of significance - costs across all problematic functions. Significance exceeds costs in three functions. The number of functions has decreased: the function «contactor search» has become irrelevant. In function «document management» the deviation has decreased. In the new concept, the business process is more efficient.

Thus, the method of value engineering allows to identify problematic, «painful» functions (points) of the business process, thanks to the functional-cost diagram construction. The method not only reduces costs, but also optimizes the correlation: significance - costs. It creates a new business process concept that is more efficient. We can say that value engineering increases the efficiency of the business processes.

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