
Methodical Aspects of Organization and Carrying out of Functional-Cost Analysis on the Basis of Process Approach for the Purpose of Expenses and Quality Optimization

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Abstract:

In Russia it is a common practice to use quite irrelevant approaches and instruments of company's business processes management that exclude detailed analysis of production peculiarities, specific character of products and current requirements of market. Therefore the paper is dedicated to one of the modern methods of economic systems' management - the functional-cost analysis. It considers a set of works on implementation and use of functional-cost analysis, describes stages of the analysis with use of IDEFO functional modelling method. In addition, for the purpose of organization of works on functional-cost analysis there is a schedule chart in the form of Gantt chart for coordination of terms of execution of work stages. Along with this the paper exposes some peculiarities of practical applying of functional-cost analysis by the example of hearing device. For this reason the research proves feasibility and effectiveness of the analysis on the basis of process approach for the purpose of further assessment of activity of Russian enterprises. The development of methodical aspects of organization and application of functional-cost analysis will promote Russian enterprises to increase the manufacturing quality level with reference to current requirements and expectations of market and to rationalize distribution of limited resources that will lead to general growth of company's competitiveness.

Key Words: *Functional-cost analysis, functions, process, expenses, effectiveness, products, quality*

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1. Introduction

1.1 Introduce the Problem

At the present time any enterprise is being complicated economic system, which is represented with aggregate of permanently functioning business processes. Therefore there is a necessity of using of process-oriented approach to quality system and production expenses management. In such circumstances, enterprise should apply number of specific methods of its recourses' management for the purpose of adoption of effective management decisions against the background of current market changes.

One of the modern methods for economic systems' functioning effective management is the functional-cost analysis. Based on assessment of significance of output products' functional features, necessary level of quality and optimal level of expenses, the functional-cost analysis allows not only introducing corrective amendments to current production process, but also developing recommendations on design of new kinds of goods and applying of modern types of production.

1.2 Importance of the Problem

Recognizing importance of conducted research in considered area we should note that many theoretical and methodological matters linked to applying of functional-cost analysis at modern stage of development are studied not to the full extent and number of states bears polemical character. At the present stage of functional-cost analysis theory development there are no methodical recommendations on organization and carrying out of the type of analysis in the framework of process approach to company management. In such a way, it is quite important to search for further development of functional-cost analysis method and its practical use that will promote increase of economic effectiveness of Russian organizations' activity.

1.3 Background

Theoretical, methodical and practical aspects of functional-cost analysis are the subject of research of many scientists. Thus, Soviet Italian-born aircraft designer Bartini developed a method, the basic concepts of which were functional model (perfect final result) and contradiction (Bartini, 1974). The functional approach of Bartini provided the basis of functional-cost analysis. The term of contradiction helped to form the algorithm for solution of inventive tasks being the main instrument of inventive tasks solution theory developed by Baku engineer Altschuler (Altschuler, 1979, 1985, 1989).

Sobolev Y.M., the engineering designer of telephone plant of Perm, applied system analysis and element-by-element development of goods. He considered each structural component a substantive part of structure, formed its functional purpose and included into group of main or auxiliary parts. Such an analysis helped to reveal excessive expenses for production of auxiliary element and reduce them without loss

of product quality. Sobolev published a number of works dedicated to the developed method (Sobolev, 1979, 1987).

The substantial contribution to development of theoretical and practical principles of functional-cost analysis was made by such economist scientists as Gramp (1071, 1978), Kovalev (1986, 1988, 2000), Karpunin (1983), Kibanov (1991), Moiseeva (1982, 1984, 2006), Maydanchik (2005).

In recent years researches in respect of development and applying of functional-cost analysis are carried out by Kuzmin (2005, 2006), Kuzmina (2002, 2005, 2011), Ryzhova (2009, 2013), etc.

Among foreign authors made considerable contribution to development of theory and practical methodology of functional-cost analysis there are Kaplan & Cooper (2008), Miles (1972), Christensen & Raynor (2003), Zimmerman & Kessler (1982), etc.

1.4 State Hypotheses and Their Correspondence to Research Design

Taking into account all the above-stated and, particularly, having defined the existing problems in methodic and practical understanding of functional-cost analysis this paper suggests the following approaches to their solution:

- it is necessary to consider the stages of carrying out of functional-cost analysis in more details and distinguish specific types of works during each of them;
- on the basis of process approach to define input and output data of the process of performance of works in the frameworks of functional-cost analysis;
- for the purpose of description of the process of carrying out of functional-cost analysis to define control actions and management mechanism;
- to develop schedule of performance of works on functional-cost analysis;
- to apply method of functional-cost analysis on the basis of process approach for the purpose of production effectiveness increase;
- to reflect practical importance of functional-cost analysis for industrial enterprises.

2. Methods

Organization of works on functional-cost analysis is a set of interrelated measures aimed at creation of necessary conditions for implementation and use of functional-cost analysis method.

To perform works on functional-cost analysis at enterprise there is a necessity of:

- 1) formation of specialized services of functional-cost analysis integrated to existing bodies and services on management, organization and preparation of the enterprise;

2) preparation of implementation of the method, promotion of its opportunities for increase of production effectiveness, method's essentials training of economic managers at all ranks and workers of general functional services, training of specialists possessing techniques and peculiarities of the method;

3) methodological support of works on functional-cost analysis with regulatory documents: instruction, provisions, standards, techniques;

4) creation of economic conditions for performance of works on functional-cost analysis and implementation of recommendations.

Organizational supervision of works on functional-cost analysis requires creation of functional-cost analysis commission.

Such commissions are headed, as a rule, by leaders of corresponding economic departments or their deputies dealing with the matters of technological development. It is being feasible to include representatives of general functional services and production departments, and also specialists and organizers of works on functional-cost analysis to their composition.

After appointment of the head and working group it is necessary to perform works on organization of measures for carrying out of functional-cost analysis.

The functional approach implies the analyzed subject is considered a carrier of definite interrelated functions predetermined by its appointment and providing the subject with the opportunity of performance of necessary set of actions or operations.

The carrier of functions can be presented with the following subjects:

- a production system or its separate element (assembly unit, production unit, part, spare part);
- a product of technical or consumer use;
- services;
- information resources;
- production and technological processes;
- business processes.

The carrying out functional-cost analysis of peculiar subjects implies gradual transition from use the method for solution of separate specific tasks and problems to its applying as the main lever for control of expenses and products' quality at all stages of their life cycle.

In such a way, we should consider it in more details, expose its nature and distinguish components of business process within every stage. Such a detailed

consideration gives more chances for getting of wished result and allows defining of the areas, in which there are most often disputable points that lead to undesired effects.

We consider the approach to modeling of the process of carrying out of functional-cost analysis at enterprise on the basis of IDEFO functional modeling method, the specific feature of which is the completeness of business process description that is reached due to availability of means reflecting control actions and feedbacks on management and information.

Thus, to get information about the state of a process and reveal areas, where there is necessity of more careful development of all the details we have used IDEFO modeling and the method of interrelations mapping for the purpose of defining of process participants' composition.

The main advantage of IDEFO method is the compliance of the format of representation of process, which allows taking IDEFO as the internal standard of organization that specify description of business processes.

The entire process of carrying out of works is performed by working group on functional-cost analysis, while the rest workers of enterprise are being participants in performance of works on improvement of production process.

As a rule, organization of works is performed with help of schedule chart for the purpose of coordination of carrying out of work stages. In the present case we suggest to use Gantt chart. Its feasibility is provided by definition of optimal way that should be covered by enterprise.

In accordance with set tasks, the paper considers the method of carrying out of functional-cost analysis by the example of such production as hearing device. The backgrounds for choosing hearing device as the analysis subject are:

- increase in demand for hearing devices;
- unprofitability of the good (high prime cost, specific consumption and labor intensity);
- necessity for elimination of number of defects revealed during its service;
- absence of induction coil for telephone conversation;
- big sizes the device, difficulties of setting and securing behind ear;
- need for frequent recharge of accumulator;
- low quality of audio presentation linked to high level of self noises;
- need for manual regulation of audio volume;
- need for increase of number of standard sizes of ear pads (5-6 instead of 3);
- unreliability of volume regulator;
- absence of tone and low frequency regulator;
- deformation of accumulator's contacts.

Ultimately, the result of carrying out of functional-cost analysis is the calculation of composite indicator of functions performance quality Q_v and coefficient of functional organization k_{org} , which reflects the effectiveness of functional-cost analysis.

3. Results and Discussion

As it was mentioned above, the modeling of the process of carrying out of functional-cost analysis was performed on the basis of IDEFO functional modeling method. The modeling of processes in IDEFO is started with creation of master diagram that forms overall view of considered process. In figure 1 there is a master diagram with “A-0” identification number. The goal of the process of carrying out of functional-cost analysis is the improvement of production process.

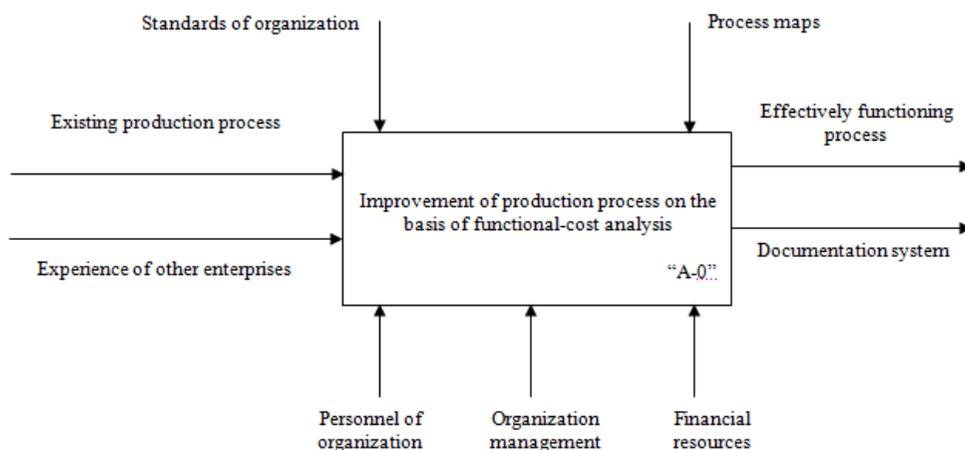


Figure 1. The “Improvement of production process on the basis of functional-cost analysis” master diagram

The input data of the process of carrying out of works on functional-cost analysis are presented with existing production process and experience of other enterprises. As a result of transformation of the process its output data are: developed system of documentation and effectively functioning process. For description of the process of carrying out of works on functional-cost analysis there are the following control actions (standards of organization and process maps for production of goods) and management mechanism (consisting of heads, personnel of organization and required expenses in the form of financial resources). Further figure 2 demonstrates the subdivision of the process of formation of functional-cost analysis into six

processes, each of which possesses its identification number, with use of decomposing principle:

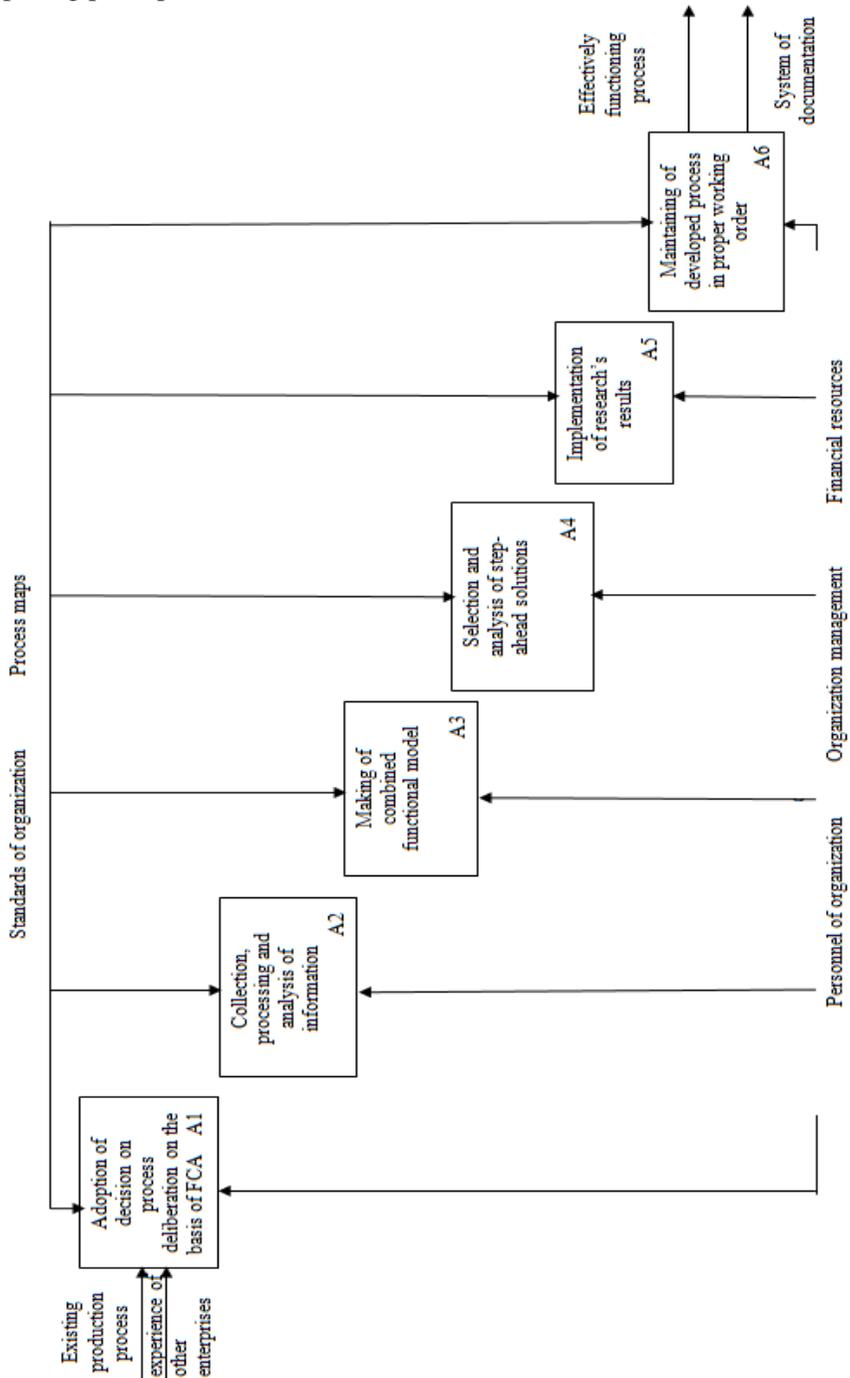


Figure 2. Decomposing of the process of functional-cost analysis organization

A 1 – adoption of decision on improvement of the process on the basis of functional-cost analysis. This stage includes:

- definition of analysis subject with corresponding technical and economic grounds;
- selection and approval of research group of functional-cost analysis;
- definition of objectives, tasks and degree of development of the method of carrying out of functional-cost analysis;
- preparation of order on carrying out of functional-cost analysis of chosen subject.

At the present stage the most important matter is the systematization of data about actual conditions for functioning of considered subject, its structural and technological features, works on improvement of production and researches, composition and structure of manufacturing expenses. In addition, at the stage the objectives of improvement of functional-cost analysis subject are specified.

The quantitative estimation of studied subject at information and preparatory stage is performed with help of making tree of goals and tasks that should be solved in the process of functional-cost analysis, making structural model and specification of expenses for its elements, identification of the most labor and material intensive elements of researched system, as well as the elements defining the level of quality and efficiency of the system in general.

A 2 – Collection, processing and analysis of process information:

- processing and analysis of information about the subject;
- making of structural model of functional-cost analysis subject.

At analysis stage external and internal functions of subject are formed, functional model is made, estimation of significance and expenses for functions on the basis of combined analysis is conducted, the task of considered system improvement is set. Importance of making functional model and difficulty of objective logical presentation of just simple objects require for meeting definite principles, rules and order of performance of this work.

Firstly, functions of item as a whole (external) and its components (internal) are revealed and formed. The significant point here is the abstracting from structural and technological realization.

A 3 – Development of combined functional model:

- determination of subject's composition and definition of relations between elements;
- definition and formation of functions;
- classification of functions;
- making of subject's functional model;
- estimation of the level of functions' performance;

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- definition of functional, problem and cost-based dependence of subject;
 - making of combined (functional and structural) model of subject, formulation of tasks for subject's improvement.

Functional and combined models, which are developed at the present stage of functional-cost analysis, promote identification of all significant relations and correlations in considered process. Expenses for functions can be identified only on the basis of their physical carrier - the technological operations that realize the functions. The easiest to identify are the regulatory expenses, calculation of which is performed by produced or supposed to be produced goods provided with technical documentation. In this case calculation of expenses is performed with use of data of combined model, in which structural model is built on the basis of technical documentation that is being efficient for considered subject. Combined models are usually not made in graphic form due to their complexity.

A 4 – Selection and analysis of step-ahead solutions:

- processing and systematization of results of creative meetings;
- estimation, discussion and selection of rational variants together with specialists of functional services;
- commercial estimation of solutions' variants in accordance with criteria selected as of the present stage;
- estimation of actual proposals;
- making of planning schedule for implementation of recommendations.

At creative stage of functional-cost analysis the ways of solution of the task of improvement of considered items and technological processes in two directions are defined:

- 1) elimination, liquidation of excessive functions;
- 2) search of effective structural and technological solutions in regard of necessary functions.

The result of creative stage of functional-cost analysis is the list of variants and processes.

A 5 – Implementation of research's results:

- approval of planning schedule implementation by management group;
- development and drawing up of corresponding documentation on implementation;
- implementation of obtained results;
- estimation of obtained results.

At the stage of work implementation on the basis of approved planning schedule the implementation documentation is developed, obtained results are checked and

estimated. In the process of implementation emerged irregularities are taken into account and eliminated, performance and quality of production process are monitored once again.

A 6 – Maintenance of developed process in proper working order.

The entire process of carrying out of works is performed by working group on functional-cost analysis, while other workers of enterprise act as participants in carrying out of works aimed at improvement of production process.

As a rule, organization of works is performed with help of schedule chart when considering terms for execution of works stages. In such a case, one can use Gantt chart. Its feasibility is stipulated by definition of optimal way that should be covered by enterprise. All subdivisions should work in accordance with documented procedures and make obligatory records about quality. Any irregularities should be analyzed by the group on functional-cost analysis for the purpose of determination of causes for their emergence and correction of corresponding information when it is necessary.

For the purpose of determination of efficiency of performed works the group on functional-cost analysis should carry out internal checks (audits), which show for how much the documented procedures and description of processes meet standard requirements (validity check) and what is the degree of understanding, execution and compliance to planned measures (conformance check). The conformance check is performed by means of comparison of actual procedures' performance with their requirements.

In case of detection of any problem on procedure performance the specialist on functional-cost analysis should discuss it with those persons, who are being directly affected by it, and find out the reason for non-fulfillment of the present requirement. If fulfillment of the requirement is being actually necessary, the head of subdivision takes measures (correcting actions) for its fulfillment by workers of the subdivision. In accordance with results of internal audit there is a report that specifies revealed irregularities and defects.

Table 1 represents a schedule for performance of works on functional-cost analysis. In such a way, the suggested recommendations on improvement of production process at the expense of sequential and detailed description promotes making of modern and effective process. Performance of the works specified above can significantly increase the probability of successful completion of project on improvement of production process at enterprise.

Table 1. Schedule for performance of works on FCA at enterprise

Stages	Time periods (weeks)												
	1	2	3	4	5	6	7	8	9	10	11	12	
Adoption of decision on improvement of process on the basis of FCA													
Selection and approval of the head of FCA working group													
Collection, processing and analysis of information about process													
Making of combined functional model													
Definition of problem and cost-based dependence of process													
Selection and analysis of step-ahead solutions													
Processing and systematization of results of creative meetings													
Approval of planning schedule													

Further we are going to consider application of functional-cost analysis by the example of hearing device and prove feasibility and effectiveness of its applying. Hearing device is a miniature sound-amplifying device designed for use by persons with hearing problems that is made of microphone, amplifier, air-conduction earphone and energy source.

At the first preparatory stage of functional-cost analysis we have studied the matters linked to state and prospects of demand for the item. The most important electro acoustic indicators of hearing device are: frequency range, maximum audio output level and coefficient of nonlinear distortion. The nonlinear distortions in hearing device deteriorate the dialog intelligibility and reduce the naturalness of sound transmission - so it is recommended them to be reduced to the maximum.

Audio signal that comes to microphone is transformed to electrical, which in its turn is amplified with help of amplifier and delivered to telephone, where there is reverse transformation of electrical signal to audio. The audio signal amplified in such a way

is perceived by human ear. The adjustment of signal level is performed manually with help of potentiometer embedded into the circuit of electric amplifier.

To define the ways of prime cost reduction and increase of goods' quality we have developed and analyzed the "tree of goals" of functional-cost analysis. The goals of the first level of the tree are the reduction of prime cost of hearing device and increase of quality of audio-presentation. Among the subgoals of the second level there are: reduction of expenses for materials, decrease of labor intensity, increase of production level, reduction of defects level, increase of reliability, etc. The subgoals can be achieved in the following ways: exclusion of deficit materials, reduction of material consumption rate, reduction of wastes, increase of production mechanization level, etc. The list the most important tasks for their realization was made with peculiar measures for actual conditions of production.

The second informational stage of functional-cost analysis included collection, systematization and all-round study of existing data about the item. To define reserves of reduction of hearing devices' prime cost, increase of design quality and increase of production rate the analysis of available documentation was conducted. The results are: defined system of parameters (indicators) of research subject that characterize its various structural and application properties (acoustic amplification, output level of self-noises, consumption current, sizes, mass); character, reasons and number of reclamations; proposals on optimization of analyzed subject; standard costs for production of the entire good and its components, etc.

Carefully analyzed are the economics of good, including expenses for purchased elements, materials and salary.

Preliminary on the basis of studying of design-engineering documents, including specifications, we have made the structural model of item. Regarding all elements (assembly units, parts) the calculations of prime cost of item's components were made, which promoted their distribution by zones of expenses with help of "ABC" method. Thus, zone A includes the biggest concentration of expenses - up to the level of 75%; the second zone B makes 20% of overall expenses and supplements the first zone to 95%, while the third zone covers the rest 5% of expenses and completes the picture of cost distribution in regard of the entire item. Ultimately, such a chart of costs built by gradual accretion of element-by-element expenses has shown that 70% of expenses is made by telephone and microphone. Another 20% accounts for low frequency amplifier and charger. The rest expenses are made by accumulator, packing, case, accessories and production of hearing device. However, to estimate actual expenses for physical carrier produced directly at enterprise (the information being necessary when solving matters about extension of production and definition of required composition and volume of works on re-equipment of enterprise) we had to perform the similar work, but without account of purchased part.

In this connection we have made the second diagram that shows distribution of labor costs in regard of the works, quality and price of performance of which depend on the level of equipment and organization of production at enterprise. The diagram demonstrated that 75% of labor costs fall at low frequency amplifier, parts of case and production itself.

The result of such representation of cost-based characteristics of assembly units and parts is the Lorenz-Pareto curve (figure 3).

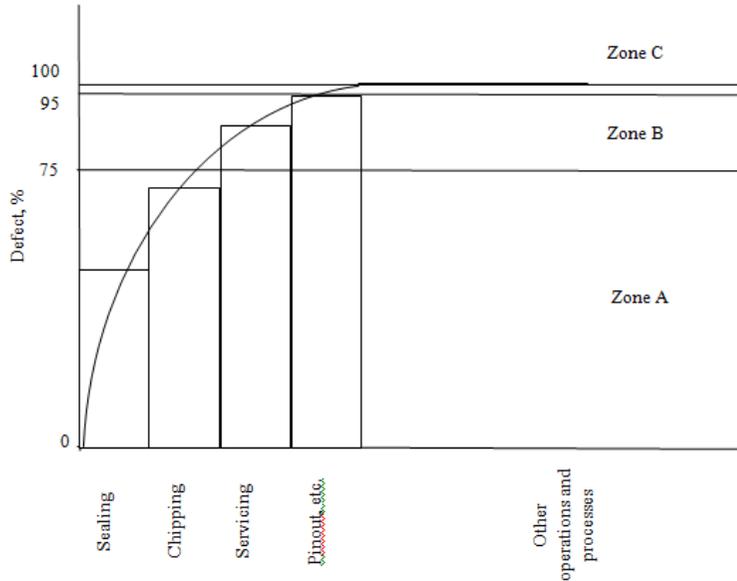


Figure 3 (a). Cost-based characteristics of assembly units and parts

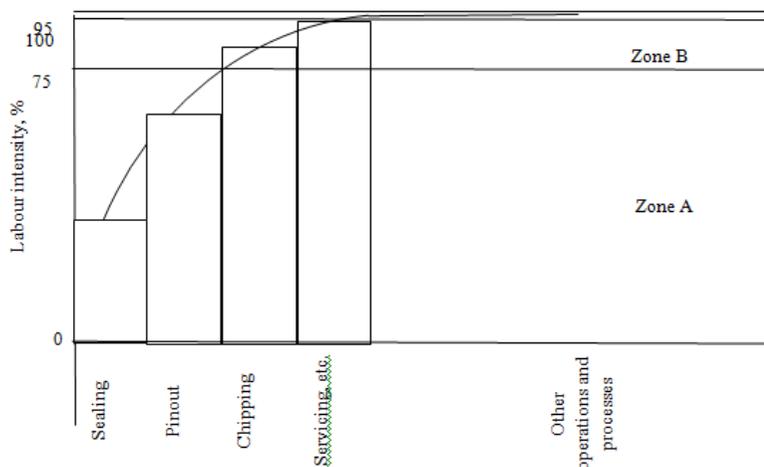


Figure 3 (b). Cost-based characteristics of assembly units and parts

The identified zones of the biggest concentration of expenses were selected as of top-priority for further analysis for the purpose of searching of the most reasonable solutions in accordance with the tasks of functional-cost analysis and their account when forming planning measures on technical re-equipment of production.

At the third analysis stage of functional-cost analysis the main task was the identification of reasons for occurrence of heavy expenses and insufficient quality level of functions' performance.

On the basis of technical specifications and consumers' requirements initially there was a statement of social demand for hearing devices - "the social rehabilitation of deaf people". On the assumption of social demand we have formed main and secondary functions of gearing device: to amplify audio signal (F1), to provide convenience of use (F2), to provide market condition (F3).

Taking into account the fact that the main function is realized with help of number of operational transformations, we have revealed general functions that reflect the operations and include functions of energy consumption, its transformation and providing of result to user. In the present case general functions were coincident with the functions performed by basic units of hearing device and defined as: "to receive signal", "to transform audio signal to electric signal", "to form intense electric signal", "to transform electric signal to acoustic oscillations". Next, there was an analysis of composition and necessity of functions performed by every element of hearing device.

In table 2 there is a functional description of assembly units of hearing device that promotes identification of useful and adverse effects of item's elements and subsequent estimation of the functions' performance.

Table 2. Results of analysis of functions of elements of hearing device

Structural element, carrier of function	Performed function	Result		Degree of functions' performance
		useful	adverse	
Low-frequency amplifier Microphone Telephone	Forms intense electric signal	+		0,9
	Transform audio signal to electric	+		0,8
	Transform intense electric voltage to acoustic oscillations	+		0,75
	Distorts the form of signal		—	

	Promotes emergence of self-noises		—	
Case	Provides market condition	+		3,0
	Provides convenience of use	+		1,0
	Provides structural stiffness	+		1,0
	Provides safety	+		1,0
Packing set	Provides convenience of transportation and keeping	+		1,0
Acoustic transmission lines set	Provides entry of audio signal to auditive passage	+		1,0
	Produces signal	+		1,0
	Provides convenience of use	+		1,0
Accumulator	Provides power for hearing device	+		1,0

With account of content of functions performed by elements we have made functional and combined models of item, which subsequently became a basis for formation of diagnostic functional-cost diagrams.

In functional model the top level is formed with main and secondary functions, second level - with main compound functions, and third - with auxiliary function. Making of functional-cost model was performed by mean of combination (the layering) of functional and structural models of hearing device.

In accordance with algorithm of correcting form of functional-cost analysis the further analysis was held for the purpose of detection of disproportions and “defect” zones. The comparison of internal and external functions in terms of relative importance for consumer, degree of their performance and expenses for their realization was conducted. The results of expert estimation of importance and relative importance of functions are presented in table 3.

Table 3. Estimation of importance and relative importance of functions

Function index	Name of function	Importance of function	Relative importance of function

F ₁	Amplification of audio signal	0,75	0,75
F ₂	Provision of convenience of use	0,15	0,15
F ₃	Provision of market condition	0,1	0,1
F ₁₁	Transformation of audio signal to electric signal	0,5	0,375
F ₁₂	Formation of intense electric signal	0,2	0,15
F ₁₃	Transformation of intense electric signal to acoustic signal	0,2	0,15
F ₁₄	Provision of stiffness	0,1	0,075
F ₁₁₁	Creation of electric connection	0,1	0,03
F ₁₁₄	Adjustment of incoming charge supply, etc.	0,1	0,0375

Distribution of expenses by functions was performed with account of contribution of every physical carrier for provision of corresponding functions. Calculation of direct functional expenses, included expenses for materials, salary and servicing of equipment related to functions was performed in combined model.

Comparison of importance of functions and expenses required for their realization was performed with help of functional-cost diagrams. The X-line of axis specified functions, while the upper quadrant of Y-line specified importance (or relative importance) of functions and lower quadrant - the share of expenses for functions in total expenses for product.

Analysis of the functional-cost diagrams has shown that there is some excess of expenses share (0,89) over importance (0,75) in F1 function. At the same time there is significant excess of expenses share (0,315) over importance (0,1) in F14 function.

To reduce the degree of disparity in F14 function we had to analyze labor and material expenses in regard of every physical carrier providing its performance, operations of technological process, types of used materials, structure, sizes; define the possibility of functions' alignment, identify unnecessary elements, etc.

The conducted analysis of expenses for F14 function has shown that the biggest expenses fall at physical treatment of case parts (66,5%). Further research helped to find out that such a situation can be explained with major part of manual work within the operation and small performance of used equipment.

Concerning functions that provide formation of intense electric signal the biggest disproportion is in F111 function (0,527 and 0,1). At the same time, in functions that provide transformation of audio signal to electric voltage the biggest disproportion is observed in F121 function.

Analysis has shown that some physical carriers alongside with useful perform adverse effects, which reduce the degree of performance of higher-priority functions in functional model. The adverse effects of hearing device's elements were ranged by the degree of importance of their elimination and difficulty of such works.

At fourth creative stage of functional-cost analysis we used techniques of brainstorming and morphological analysis, as well as the massif of non-implemented rationalization proposals that was found at enterprise. Taking into account the fact that from among probable variants of solutions on improvement of functions' performance we could select only solutions, realization of which had not affected internal organizations (including suppliers of purchased items), further we will consider the variants that meet this condition.

The first place in the degree of importance of defects' elimination is taken by F111 function. The physical carriers of the function are the assembly card and the contact, which caused deformation of card due to its contact to it and short circuit in microphone and telephone due to its correlations. Change of structural solution by way of transferal of contact to the case provided elimination of adverse effect and increase of degree of performance of functions exercised by the physical carriers.

Besides, the transferal of contact from card to case promoted elimination of short circuit in microphone and telephone, increase of functional design of hearing device, simplification of card assembly, which means reduction of expenses for assembling. In addition, we have studied the possibility of card's material substitution from glass-fiber laminate to ceramic, which promoted reduction of expenses for materials and increase of card's reliability.

To eliminate occurrence of thermal effects in microchip we had to change its schematic design, while to reduce expenses for assembling we had suggested the variant of chip's attaching to card. For the purpose of elimination of elements' adverse effects that distort signal and naturalness of sound in microphone and telephone we had to select a new material for absorber, analyze the structure of telephone and microphone, mechanize the process of absorber's setting to case, strain of absorber to microphone and telephone, etc.

At fifth research stage of functional-cost analysis we have conducted complex estimation of existing and suggested variants of good's design. In our calculations we considered functionally required production expenses as per unit of good, specific additional capital expenses required for implementation of recommendations on good's improvement; complex index of quality of function's performance O_v and coefficient of functional organization k_{org} . As far as specifications of item, the value of which is fixed in technical notes, remained unchanged in both - existing and improved variants of hearing device, the value of O_v index for each v -th variant was defined on the assumption of the degree of y_{jv} functions' performance and their relative importance R_{Fj} by formula (1):

$$Q_v = \sum RF_j * y_{jv}, \quad (1)$$

Calculation of korg of good before and after FCA has shown increase of the index from 0,362 to 0,504.

The coefficient of integral quality was calculated on the assumption of amount of expenses decreased by the value of complementary parts' cost, since the opportunity of reduction of prime cost of complementary parts making significant part of general functionally required expenses for hearing device was the prerogative of supplier plant.

The conducted calculations demonstrated that expenses for production of new improved variant had made 0,78 of basic indicator, while the index of integral quality of hearing device had just increased after carrying out of functional-cost analysis.

This will undoubtedly influence the volume of sales of the product and improve general financial and economic indicators of enterprise.

4. Conclusion

The present research has proven the necessity and effectiveness of carrying out of functional-cost analysis. The methodic recommendations on organization and carrying out of the analysis considered in the paper will help to solve some problems of implementation of functional-cost analysis in company's activity, among which there are:

- difficulties of psychological nature linked to high level of anxiety and low level of motivation of managers in regard of implementation of progressive methods of cost management;
- informational difficulties linked to weak development of methodology for carrying out of functional-cost analysis.

Calculations linked to effectiveness of carrying out of functional-cost analysis reflect organization's opportunities that promote:

- regular carrying out of output products' modernization in accordance with current requirements and expectations of consumers;
- increase of efficiency of resources invested in production of goods with reference to importance of separate elements of structure in realization of product's functional potential;
- finding out of potential reserves for cost saving;
- finding of optimal structural and technological variants of production.

Besides, it is necessary to note that functional-cost analysis can be used not only for improvement of production process and development of recommendations on

designing of new types of production - with its help one can improve the strategy planning of organization's activity. In addition, functional-cost analysis provides opportunity of making sound strategic decisions on production price-fixing, proper combination of products, investment in scientific research, processes' automation and promotion.

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