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Methodology of evaluation of value created in the productive processes

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ABSTRACT

Purpose: Of this paper was to present the methodology of analysis of the productive processes with application of value analysis and multi-criterion-analysis which allow to evaluate the technology and organization of the productive processes.
Design/methodology/approach: Presented in the paper methodology of evaluation of the productive processes is based on analysis of activities in the productive processes and their characteristics with reference to created value in the productive chain.
Findings: The paper presents elaborated by the author methodology and computer application for application in the chains of the productive processes.
Research limitations/implications: Presented methodology allows to evaluate effectivity of the productive chains connecting aspects of the management and economics of the process.
Practical implications: Presented methodology was used in analysis of the productive chains and their effectivity, and also as a benchmarking instrument.
Originality/value: The paper presents originally elaborated computer application for the value added analysis in the productive chains.
Keywords: Production and operations management; Production planning and control; Manufacturing technology management; Quality management; Supply chain management; Productivity and performance management

1. Introduction

The present problems of evaluation and monitoring of productive processes become one of the most important links in undertaking the management decisions so from point of view of economics of production as of practical technology [9, 10, 25, 28, 32].

Improvement and modernizing of finished products or productive systems requires consequent solution of problems, often at all rungs of management. To do it, a lot of methods, organizing and rationalizing techniques is used; however there is no universal method, and each of them has its area of application and destination where its effects are possibly the largest. Among many methods one could distinguish value analysis [5, 18, 20, 21, 25, 31].

Evaluation of value always correlated with evaluation of quality. Value is not identical with quality but it results from it. The production of high quality, but cheap articles, is associated with solution of number of problems in macro- and microeconomy. It is connected with application of suitable productive materials, modern technologies as well as the techniques of organization of production [17, 32, 33].

The quality of the product as the parameter characterizing the product and its productive process is an important element of information concerning its product. The demarcation of technical and economic sciences on stage of undertaking the right decisions concerning evaluation and monitoring of productive processes, becomes incorrect and it in inadequate manner – regarding values carried in by both sciences – limits obtained results in driven analyses.

With reference to processes realized in the firms it should be established how each process influences the ability to realization of defined requirements [31]. Important is analysis of costs and quality of the process [12, 19].

In the literature one could find three such coefficients which influence the success of the firm:

- quality,
- cost,
- time.

The high cost of the production need not testify to high quality of the product.

So, present productive strategies are based on three main parameters: time, costs and quality describing productive ability of the firm, with which one can describe and evaluate every technological process [1-4, 7, 11, 23].

Acceptance the strategy of minimal costs by the firms permits to form a position of predominant producer [16].

All this induces to consideration about meaning and influence on formation of modern productive processes through above characterized factors: quality, time and cost (Fig. 1).

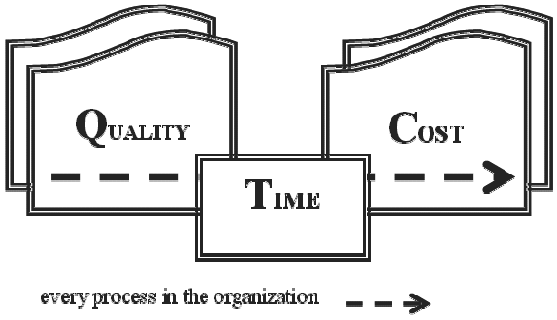

Fig. 1. Criterions of competitiveness in order of realization in the organization

The element connecting these factors is technology, which generates value of the product through formation of the costs and quality of the offered product [12, 21, 24, 26].

One cannot also divide the technology of the production from the time of realization which nowadays is one of the most important factors characterizing the reaction of the firm on the changes of the environment and placed requirements. Value of the product is the result of the good working chain: supplier-firm-customer [12].

Nowadays the projecting of the processes should be based on material, real, objective and scrupulous confrontation of the customer's needs with:

- productive possibilities of the firm,
- carried costs in the limits of organizational and productive system,
- offered quality of the product basing on modernity of applied technologies.

This is why usage of high technology is the distinguishing factor creating standards of the products [13, 14].

The analysis of value is one of the basic methods of preparation and undertaking the decision of choice of correct solution, it enables to solve complex problems in a transparent and effective way [5, 8, 21].

In the organizational aspect of realized processes, reducing the own costs can be based on two methods [14, 16, 17]:

- change of technology,
- change of organization of production.

The trends in modernizing of production in the world industry result from accepted by high developed countries organizational and technological strategy of development, which aim is to create the problems resulting from market needs, what permits to treat it as a total strategy of the present firm steered on new activities.

Nowadays the following elements are the determinants of firms' competitiveness [4, 17, 19, 27]:

- technological and qualitative level of the product,
- level of technology and machine-park,
- competences of marketing, engineering and technical personnel,
- participation of financial surpluses in the increasing of technological and marketing possibilities of the firm.

Considering only financial coefficients in the evaluation of the productive processes does not answer the questions: What kind of activities can be done to realize economic value which conditions us the position of the competitiveness on the market? As premises to undertaking the activities tending to realize tasks increasing efficiency of the productive processes, one can *a prori* accept modification of technology of the production inconnection with the process of modification of the organization of the productive process, and also – going further – look for innovatory solutions in the pre- and post-productive sphere, including projecting and marketing [11, 24, 31].

The purpose of the properly made analysis of the realization of the productive process is to show gaps existing between present possibilities of the driven process and the same or similar process driven in the competitive firm or modified process. The gap which arises is the determinant of the change in the technology of production, and also organizational procedures and creation of the connections in the productive chain [9, 10, 11, 17, 19].

During the realization of the productive processes we deal with causative-consecutive relationships which are forming them. These relationships are described by quality of the processes, time of the duration and term of realization of the given productive process. The activities based on such schedule aim to improve of term of realization, quality of processes, diminishing time of duration of processes. It is then seen in financial results, particularly in created profit, and stabilization of the position of the firm on the market [4, 6, 7, 15, 18, 20, 25].

The author of this study accepted the coefficient V to the evaluation of created value in the productive processes. Coefficient V describes quotient of increase in the costs of the activities adding value to the value of the product, for which one accepted the price of the product. From the point of view of the customer this value should be maximal, what can make, that at the purchase the customer will cover the costs mostly associated with the production of the given good, but not the indirect costs or the costs not influencing the form of the product. From the point of view of the firm this value should tend to minimum, what will testify about more profitable technological and organizational solution of the process (e.g. lower costs of the applied technology). In the aim of complex estimation one should make calculation of effectivity according to costs and time. The processes should be economically analyzed, with particular description of the costs, most profitable using method ABC (Activity – Based Costing) [12, 25, 29, 32].

2. Experimental procedure

Concept of every productive process brings desire to create goods at value which is greater than costs of production, so allows to achieve profit and competitiveness of the firm. Costs associated with production increases with every stage of realization of the process, but with every stage the value should grow. Increase of value describes accumulation of value taking place in successive stages of production. Realized productive processes should be so constructed that every successive stage in the productive cycle leads to effective creation of value. One of methods of evaluation of productiveness of realized processes is analysis of value added [4, 9, 12, 17, 20, 23-25, 28, 33].

M. Porter indicates to distinguish in the productive process activities made by the firm which should generate value in purpose to evaluate value created by the firm [23]. Generating of value could be a source of competitive dominance of the firm. The firm should make a diagnosis of activities not bringing value in the realized processes through which it induces strategy of continuous improvement of them. Not all the activities, operations or procedures in the productive process create the value. One could introduce division of tasks on these which will directly or indirectly create value, and on those which do not create the value (Table 1) [9, 10].

Table 1.
Division of operations according to characteristics of value created in the process [34]

Operation	Characteristics
Directly creating value (real-value-added, RVA)	The operations for which the customer could pay because they fulfill his needs
Indirectly creating value (business-value-added, BVA)	The operations which the customer accepts on condition that they are necessary to create the goods and directly or indirectly influence created quality of the product
Not creating value (no-value-added, NVA)	The operations which are not accepted by the customer because they do not influence on value of the product

Ideal process of creation of value added should consist of productive processes and of processes which allow to assure control of quality in purpose to supply the customer the product with features fulfilling determined specification.

The success of the firm is measured mostly by means of generated profit. The more flexible firm is the more elastic it adapts into turbulent environment generating in the realized processes products fulfilling demands of the customer, in the quickest time, at the most favourable prices, at minimal own costs. The flexibility of the firm depends on defined organizational system, means of analysis of the processes, as well as infrastructure of the firm [11, 16, 19, 30].

Looking for ideal solutions derives from the method by G. Nedler depending on decomposition of the whole organization – process, analysis of the successive stages – and their rationalizing and connection in one new system. This method presents sense of nowadays advertised systemic approach. So called Triangle of Nedler shows this method (Fig. 2) [25].

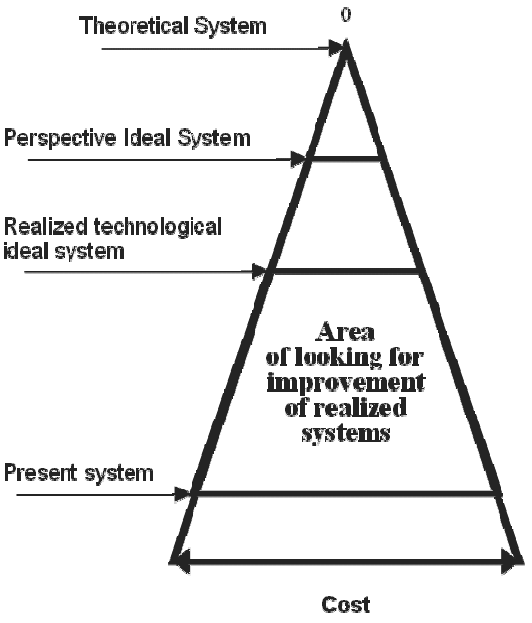

Fig. 2. Triangle of Nedler [25]

Nowadays presented look at productive processes realized in the firm insists on connection of every element of the productive processes and on creation value for the customer in each planned activity with assurance that increase of the price achieved by every activity is greater than its production [28, 32].

Range of realized activities in the processes and the processes alone is very differentiated from one department to many departments and functions. Range of processes depends on type of undertaken activities tending to creation of complex groups of interdependent activities. In such a system we receive the productive chain connected of number of elements determining different operations realized in the productive chain in one or many firms [28, 32].

All above mentioned impels to look on productive processes from perspective of value creation in the range of the firm or productive chain comprising a lot of enterprises and concerning one process.

Such an analysis one could conduct by means of value analysis suggested by the author. It depends on isolation of individual activities in the analyzed productive process and determining costs of these activities by use of ABC method. The result of so made analysis is determining the times and the costs adding and not adding value to the product along the whole productive chain [25].

Studies conducted until now revealed that participation of times and costs of logistic operations is great and constitutes about 10 percent of costs of production (as it is for instance in machine industry in the productive operations of typical parts of the machines as cogwheels, rollers) [26, 28, 29].

During own studies computer application was suggested and performed which help in value analysis for the productive processes. Effect of its application is generating of data and imaging of the process by usage of chart of value (Fig. 3) [25].

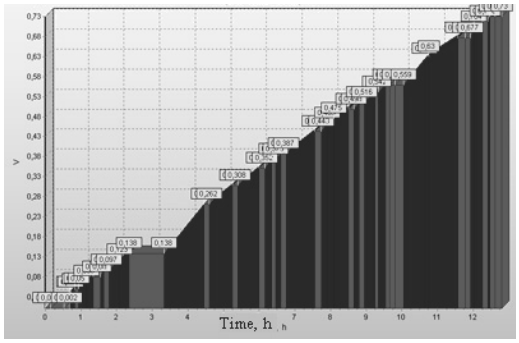

Fig. 3. Chain of creation of value added for the process of gear production (number of operations-55)

The Figure presents value added for the chosen productive process. So conducted analysis allows to look at the productive chain in the means connecting information concerning aspects of management and applied technology of production. The same product can be created by number of means, however in the conditions of acceptance of some limitations and criteria in the whole collection of solutions, there is one the most optimal, assuming that all the solutions fulfill basic requirements concerning quality of the product.

Elaborated instrument assisting presented in the article approach to the analysis of the productive chains allows to evaluate time and cost effectivity of individual types of activities realized in the processes – Table 2 [26].

Table 2.
Analysis of time and costs not bringing value added in the process of production of gear

Operations which do not bring value to the final product	Cost (% of total cost of production)	Time (% of total time of production)
Storing	1.04	1.54
Transportation	9.70	8.70
Preparing to control and Control	12.56	10.86
Together	23.30	21.10

All above mentioned allows to evaluate cost and time effectivity for the whole productive chain.

In purpose to confirm validity of the established analyses the author of the article suggests to make easy multi-criterion analysis of the productive processes which is presented below.

The purpose of the analysis of the processes based on economic parameters is to indicate the process distinguishing because of some values. To receive better evaluation of the processes, multi-criterion analysis was done which allows to describe the process in the form of undimensional value.

In the purpose of evaluation of processes, the function of usefulness of the process was applied. It is based on received results of examined real processes, including costs, time of realization and lacks. Multi-criterion function of usefulness was used (1):

$$F_{up} = \sum_i \left(w_i \cdot k_i \right) \tag{1}$$

where:
F – value of the function of usefulness of the process,
k_i – value of criterion,
w_i – value of weight.

The advantage of this method is its simplicity and readability. Three chosen criteria were accepted. The function tends to the minimum for so accepted criteria. The criteria refer to the quality, time and costs of the production. Successively, following coefficients were used:

- For the quality: valuable coefficients of costs of lacks (2), defining proportional relation of costs of lacks to profit from the production

$$K_J = \frac{K_b}{Z} \tag{2}$$

K_b – costs of lacks,
Z – profit.

- For the time: valuable coefficient of time of production (Manufacturing Cycle Effectiveness) (3), defining proportional relation of technological time of production to the whole time of production:

$$K_C = \frac{T_w}{T_o} \tag{3}$$

T_w – technological time of production (time of technological operations),
T_o – operational time – sum of times: production, quality control, transportation and storing.

- For the costs: valuable coefficient of costs of production (4), defining proportional relation of costs of production to profit from sale:

$$K_K = \frac{K_w}{Z} \tag{4}$$

K_w – cost of production,
Z – profit from sale.

Successively, an evaluation of productive chains could be made using a coefficient of productiveness according to value added – P_{AV} (5) [10], which was defined as the relation of value added to the time of production t_w:

$$P_{AV} = \frac{C - K}{t_w} \tag{5}$$

C – price,
K – costs of production.

The values of weights to calculations suggested by the author originated from the conducted questionnaire study for the machine and metallurgical industry in which criteria important for these two branches of industry as criteria of selecting the suppliers were distinguished.

Analogically one could accept that these criteria should be also applied in evaluation of those who evaluate, and in particular processes realized by them.

3. Summary

Aspiration of productive firms to achieve competitive predominance in the market is associated not only with the sphere of utilization of effective technologies of production but also with the formation of the whole organizational system.

So, each of functions realized in the firm has to form effectivity of the firm, taking into consideration not only specificity of individual functions, but also impact on realized processes.

Hence, according to the accepted model of analysis of the effectivity of the firm as relation: Input-Output, this dependence could constitute for instance relationship of time of realization of all the activities concerning the process to the time of technological realization of the process.

Presented approach to practical usage of value analysis joints look through technology and economy at productive processes. It allows to define associations of technology and organizational system appearing in the process. In such a way it allows to determine effectivity or productivity of individual processes realized in the firm.

As this was demonstrated in the studies made by the author, logistic process, which was considered until now as auxiliary process in comparison to productive process or the productive chain, depends mostly on accepted by the given organization solutions in the sphere of preparation and management of production.

Modern look at logistics with reference to management in the firm went through evolution from concept of management in pasaage of goods and information to concept of logistically orientated management

Modern trends in management of logistics are directed to the Supply Chain Management – creation of organizations with process approach.

Made by the author analyses and researches about the supply chain management is one of the trumps in effective management of the productive process achieving much more respect among firms of not only motor or transport industries.

Presented in the study approach to analysis of productive chains through prism of criterion of value created in them, and in particular obtained results, confirm the thesis, that strategy of economy based on analysis of value described above, is an efficient instrument allowing to reach competitive position by economic subjects.

Analysis of value and its application to the evaluation and optimization of processes and productive chains brings a lot of strategic information for the firms. A modern approach to costs concerning production (based on the formula: profit from the product determines the difference between price established by free market and costs of production of the given good) describes the direction of activities: making the profit maximal – reducing the price to the minimum. As in the example described above one can see that not only elimination of operations not bringing value (creating the costs), but also suitable selection of operations bringing value, has its influence on formation of economic results of the firms. It should be emphasized that one of the difficulties of so suggested approach there is initiating the calculation of costs of the activities in the firms as a tool of management in economics of production.

Nowadays competition is a necessary element of formation of strategy of the firms on the market.

Three above characterized factors: quality, time and cost are very important in achieving success by the productive firms.

The basic element – forming effectivity of the realized processes – is technology, which generates the value of the product. The technology of production is associated with the organizational system.

Formation of the value in the productive processes and its monitoring is presently a domain of formation of effectivity of the productive processes. Making an evaluation and an analysis of the processes and the productive chains by the firms is the basis of taking strategic decisions in technological, organizational and economic aspects.

Identification and elimination of waste in the productive chains is becoming the main rule of maximization of value added through reduction of all the actions generating costs and not bringing value to the product.

Costs associated with the organizational sphere constitute a great part of the costs of the process and their diminishing can be a basis to decrease the total costs of the production and increase effectivity of the realized productive processes even when hitherto existing technology of production is retained.

All this is associated with the necessity to understand of all the actions essential to create a concrete product and to improve a realized productive process – from point of view of the last customer.

Presented in the paper means of evaluation is one of the methods. The meaning of created in the productive processes value was shown as one of the main economic coefficients which allows to evaluate the productive processes.

Suggested in the paper means of evaluation of the processes with use of some defined econometric coefficients refers to three main parameters: time, costs and quality, and is simple and univocal.

Such look at the productive processes allows to assess productiveness of realized processes through created in them value and to seek for ways of building the success.

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