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Mathematical Model of Adoption of the Administrative Decision as Means of Increase of Competitiveness of the Industrial Enterprise

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Abstract: Increase of competitiveness of the enterprise assumes introductions of new production technologies and the management, focused on continuous updating of output, substantial increase of its quality and also emergence of possibility of management of assortment of let-out production. In this article the methodical approach of creation of a card of profitability of a product at the enterprises with complex processing of raw materials is considered. On its basis creation of model of adoption of the administrative decision on the range of products of line processing of raw materials with use of a method of dynamic programming of discrete processes is offered.

Key words: Management decision · Competitiveness · Optimization of expenses · Dynamic programming · Card of profitability of a product

INTRODUCTION

The modern enterprise is a difficult, constantly developing system. All principles of optimum performance are applicable to the enterprise as to system: complexity, dynamic likelihood nature, hierarchy of construction, focus of functioning, allocation of the general and local criteria of an optimality, limitation of resources, economic choice and diversity of development. It allows to consider the enterprise as cybernetic system and to apply in relation to the enterprise a cybernetic approach [1]. Use of a cybernetic approach gives the chance to construct an enterprise management system considering influence of factors of internal and environment. Management of the organization should monitor and analyze surely all external factors, such as state of the economy of the country, scientific and technical progress, activity of suppliers, consumers, competitors. It will allow the enterprise to adapt to changes out of the organization normally to function and remain competitive in the market of let-out production [2]. But after all a power source of the organization is the internal environment in which usually allocate production, shots, finance and marketing. Interaction between blocks of the internal environment is carried out to means of various decisions which can both is positive and negatively to affect organization activity. In separate independent type of decisions allocate administrative decisions. Adoption of administrative decisions-the most important kind of activity which is carried out by the manager. And process of preparation, acceptance and implementation of administrative decisions, being one of binding processes, penetrates all administrative activity [3].

Difficulty of an assessment and comparison of alternative versions of the administrative decision consists in impossibility of the actual experiment. Therefore mathematical modeling gives the chance to the manager the reliable tool and for "fittings" the administrative decision on a concrete economic situation. And wide variety of methods economic-mathematical modeling allows to increase considerably efficiency and productivity of the developed administrative decision, allows to lower considerably probability of the erroneous decision leading to decrease in profitability and competitiveness of production.

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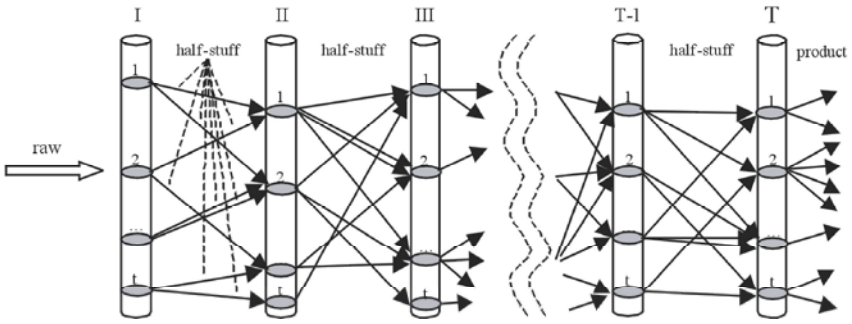

Fig. 1: General scheme of multistage process

In nonferrous and ferrous metallurgy, in the industry of construction materials, in the chemical, petrochemical and koksochemical industry, wood-sawing, meat and milk, food industry complex processing of raw materials is widely applied. complex productions differ special complexity of technological processes, a variety of methods of processing of raw materials and also diversity of use of the same products in various final commodity products. For example, in productions of oil refining there is a possibility almost all passing products and the waste received together with main, without excessive expenses, economically to turn into the substances which are not conceding on quality and consumer properties of production of specialized, directed processes. Therefore at the enterprises making decision on product realization to foreign consumers or about its use in further deeper processing occurs to complex processing of raw materials intuitively or on the basis of the signed contracts and agreements.

For acceptance reasonable administrative the decision on processing of a semi-finished product or on its realization and for definition of the income (loss) on considered repartition of process of processing in article is offered to use mathematical model on the basis of a card of profitability of a product [4]. A card of profitability of a product as the interior of the administrative report, pays off with use of a method of dynamic programming for discrete processes.

Main Part: The main task of the created economic-mathematical model is search of the administrative decision at the enterprises which provides possibility of optimization of expenses and results of processes of processing of complex raw materials for the purpose of increase of profitability of production and competitiveness of production.

Let's consider the scheme of realization of an objective.

This problem of management can be solved by means of a classical task about replacement of dynamic programming [5, 6]. A question of, whether it is necessary to carry out further processing of a semi-finished product or to realize it, is defined by semi-finished product cost, costs of its further processing, costs of storage and product transportation and also the income as a result of acceptance of one of two options of actions, competitiveness of production in the market.

Let's enter the following designations: T-number of repartitions of processing of initial raw materials; t-the current repartition considered in model; c(t)-the prices of realization of a product or semi-finished product for repartition $t \in T$; z(t)-costs of production of a unit of production or its semi-finished product for repartition $t \in T$; zp-costs of realization, storage, transportation of a product (semi-finished product); $f_T(t)$ - the maximum income received from a product of repartition t for the remained T repartitions.

On fig. 1 let's present the general scheme of multistage process where we will designate in figures I, II, III, …, T-1, T stages (repartitions), in figures 1, 2, …, t - process number on repartition I, II, III, …, T-1, T. Shooters show an exit of semi-finished products on each process of repartition. On an entrance of multistage process the raw materials for complex processing arrive and on an exit finished products turn out. As it was noted above, practically each semi-finished product of process t on repartition T it can be realized or transferred to the following repartition for further processing and this decision should be accepted at each stage T.

For formation of a total cost of a product of pastT processing stages, we will represent accumulation of its profitability in phase space ZOt (Fig. 2).

System condition S_{t-1} after a step (t-1) it is characterized by a vector of two components the income $\{c(t-1)-z(t-1) + f_t\}$ if the product goes on processing and $(f_0 + zp)$ in case of realization of a product and number of

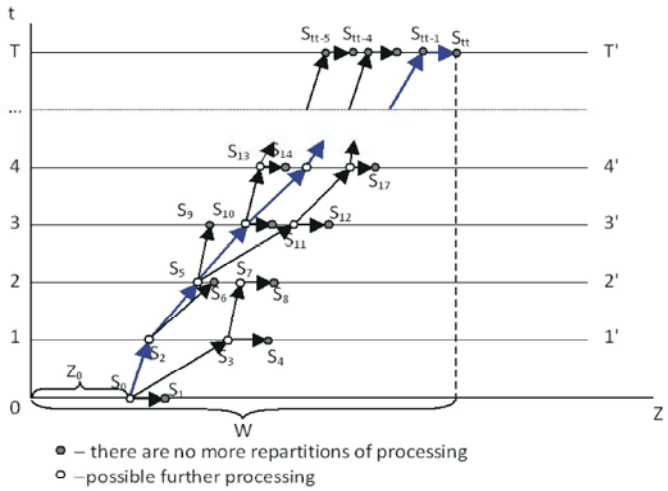

Fig. 2: A condition of system of processing in phase space

last repartitions. Function $f_T(t)$ - the saved-up income of the previous stages of processing. On an axis of ordinates straight lines 1-1', 2-2', …, T-T' reflect repartition of multistage process and on an axis of abscissae the total income of the received semi-finished product is postponed $Z = f_T(t)$. The initial condition of process of processing is defined by a point S_0 on an axis OZ with an abscissa Z_0 (initial cost of raw materials). If the product goes on the following process of repartition, the point moves on the phase plane across. If the product passes to the following repartition, the point moves from this horizontal straight line on following one after another with shift equal to the added value of a product. Condition S_{tt} treats a product which is bringing in the maximum income W. If to lower perpendiculars from all conditions S_t on axis of abscissae, it is possible to find the income by each type of production of complex processing. The income will develop of the sum of the income of each repartition $W = w_1 + w_2 + \ldots + w_T = \sum_{t=1}^{T} w_t$.

The functional equations based on a principle of an optimality [5, 7], we will present in a look:

for one-process stages

$$; f_T(t) = \max \begin{Bmatrix} c(t) - z(t) \\ -zp \end{Bmatrix} \begin{matrix} \text{production} \\ \text{realization} \end{matrix}$$

for T-process stages:

$$f_T(t) = \max \begin{Bmatrix} c(t) - z(t) + f_{T-1}(t+1) \\ f_{T-1}(0) - zp \end{Bmatrix} \begin{matrix} \text{production} \\ \text{realization} \end{matrix}$$

The presented equations are recurrent ratios which allow to define size $f_T(t)$ depending on $f_{T-1}(t + 1)$. The structure of these equations shows that upon transition from one process of a stage to the following the number of processes increases with t to (t + 1) and the number of the remained stages decreases with T to (T-1). That is T = 1 means that there was one stage (repartition) before completion of multistage process and T = T corresponds to that process only began and remained T stages.

In the equation difference (c(t) -z(t)) expresses profit on production of a product (semi-finished product) at a stage T processing, beginning from the end and function $f_{T-1}(t+1)$ characterizes total profit from (T-1) the remained stages of production with number of processes from the beginning of implementation of production equal (t + 1). Function ($f_{T-1}(0)$ -zp) characterizes the income of production of a product, a past (T-1) repartition minus of an expense for storage, transportation and sale.

These ratios give the chance not only to choose a line of conduct at the solution of a question on production or product realization, but also to define the profit received at adoption of these decisions on any repartition of production. For this purpose it is necessary to make a card of profitability of a product (Table 1). The ambit in the table shows that at the left the greatest income will be received at further processing of a product and on the right-from its realization. From the constructed card of profitability the line of conduct concerning a product (semi-finished product) can be easily defined.

This model will allow to help to the manager to make the decision on number of installations (repartitions) of processing of raw materials, that is to optimize redistribution of streams of raw materials between installations.

Table 1: Card of profitability of a product

	T					
Income $f_T(t)$	0	1	2	3	…	T
$f_1(t)$	$f_1(0)$	$f_1(1)$	$f_1(2)$	$f_1(3)$	…	$f_1(T)$
$f_2(t)$	$f_2(0)$	$f_2(1)$	$f_2(2)$	$f_2(3)$	…	$f_2(T)$
$f_3(t)$	$f_3(0)$	$f_3(1)$	$f_3(2)$	$f_3(3)$	…	$f_3(T)$
…	…	…	…	…	…	…
$f_T(t)$	$f_T(0)$	$f_T(1)$	$f_T(2)$	$f_T(3)$	…	$f_T(T)$

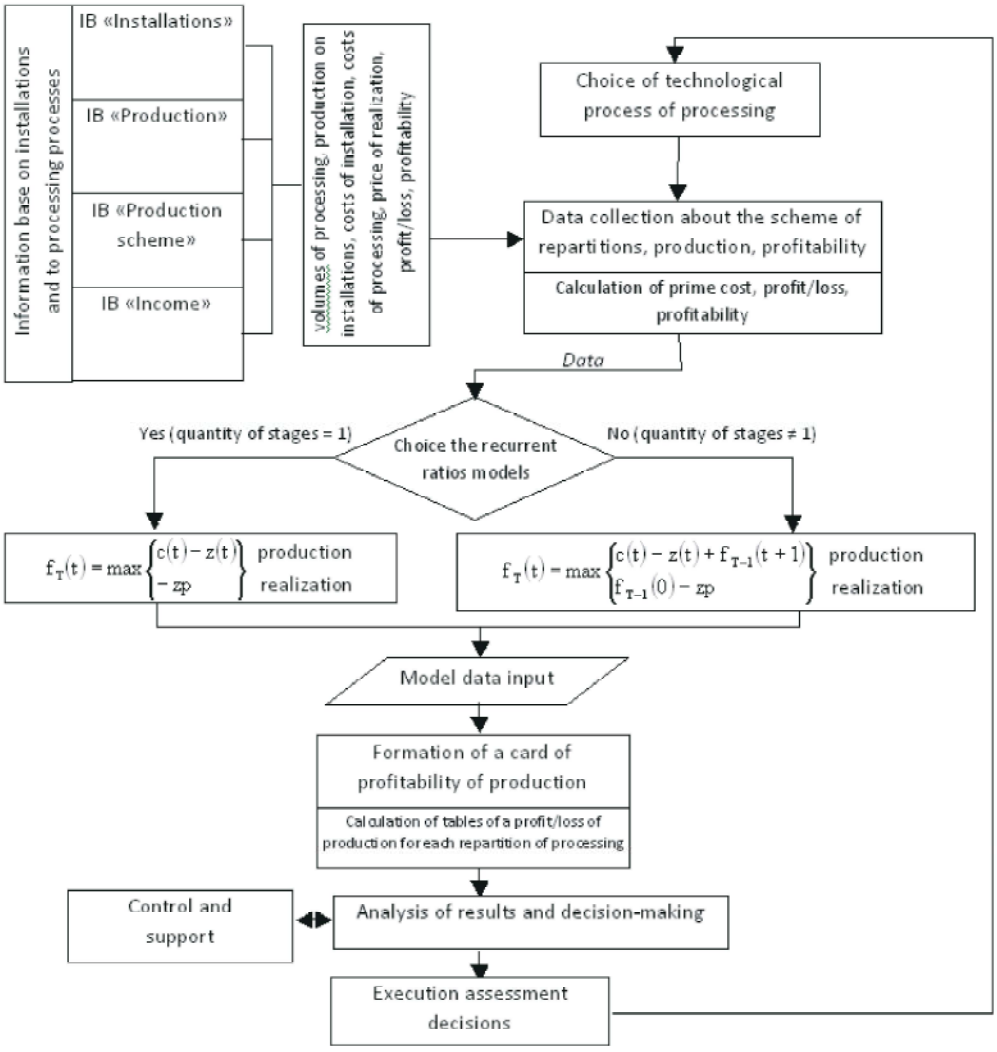

Fig. 3: Scheme of modeling of a card of profitability of a product

At any enterprise of processing of complex raw materials there is a task about increase in depth of processing, that is reduction of the remains of processing and increase of volumes of an exit of finished products. This task is solved by means of management of technological modes on repartitions and modernization of the technological scheme of production. On the other hand, economic efficiency of processes of processing too is an important indicator of work of the enterprise [8]. To find balance between economic and technological components of process of processing it is possible by means of a card of profitability which considers not only features of technology, but also analyzes economic efficiency of processes. Practically on any repartition of

line processing the card will allow to calculate profitability of production on processes. And decisions on possibility of realization of a semi-finished product after completion of process or the decision on further processing of a semi-finished product will be reasonable.

The constructed model allows to track dynamics of profitability at the enterprise. The general interrelation of data between various sections of model allows to carry out the analysis of a production situation at any changes of the technological scheme of production. The general scheme of a technique of formation of a card of profitability is presented on fig. 3 [4].

For preparation of a card it is necessary to choose process of processing of a product, of information base of the enterprise, to prepare data on processing volumes, costs of installation and processing, prime costs of ton of initial raw materials, costs of realization, storage, transportation of a product (semi-finished product) and also about the price of a product (semi-finished product) and then to execute calculation of prime cost of products for each repartition, to define profitability of semi-finished products [9].

To execute input of the received data in the developed model of a card taking into account quantity of stages of processing. To analyse results of the created card of profitability, to estimate results and to choose from alternative will be the most reasonable administrative decision.

CONCLUSION

The developed model will allow to help to the manager to make the decision on number of installations (repartitions) of processing of complex raw materials, that is to optimize redistribution of streams of raw materials between installations. To find balance between economic and technological components of process of processing it is possible by means of a card of profitability which considers not only features of technology, but also analyzes economic efficiency of processes [10]. Practically on any repartition of line processing the card will allow to calculate profitability of production on processes. And decisions on possibility of realization of a semi-finished product after completion of process or the decision on further processing of a semi-finished product will be reasonable.

The methodical approach presented by us to creation of a card of profitability allows to track dynamics of profitability at the enterprise as a whole and the general interrelation of data between various sections of model allows to carry out the analysis of a production situation at any changes of the technological scheme of production. It would be desirable to notice that at the enterprise not always it is possible to follow optimum strategy, but the constructed card of profitability of a product will allow to count profit or a product loss, to estimate its profitability.

The presented model can be easily adapted for changes of a market situation, to changes of capacities and enterprise strategy. The card of profitability of process of processing allows to make reasonable administrative decisions which lead to decrease in expenses at implementation of the inefficient decision and also to increase in profit as a whole on the enterprise. But development of universal software product on the basis of the developed technique would allow to lower more costs of development and method adaptation at any enterprise complex processing of raw materials with any technological scheme of processing.

CONCLUSION

The developed methodical approach to creation of economic-mathematical model of optimization of expenses with use of a method of dynamic programming will allow to carry out effective regulation of a production activity of the enterprise, will give the chance to management to increase competitiveness as processing products and production as a whole. The card of profitability of process of processing allows to make reasonable administrative decisions which will lead to decrease in expenses at implementation of the inefficient decision and also to increase in profitability as a whole on the enterprise.

REFERENCES

1. Tchizhova, E.N., 2002. Rationalization of enterprise activity: Monograph / E.N. Tchizhova-SPb.: Himizdat, pp: 342.
2. Nikitina, E.A., 2007. Assessment of competitiveness of industrial enterprises / E.A. Nikitina//Messenger of the Belgorod university of consumer cooperation, 4(24): 176-187.
3. Drury, C., 2007. Cost and Management Accounting. South-Western: Cengage Learning, pp: 596.
4. Rudychev, A.A., 2011. Problems of optimization of expenses at the enterprises with complex use of raw materials: monograph / A.A. Rudychev, I.A. Slabinskaya, O.V. Domozhirova, S.P. Gavrilovskaya. Belgorod: BGTU publishing house, pp: 142.

5. Dimitri, P. Bertsekas, 2007. Dynamic Programming and Optimal Control. Athena Scientific, pp: 1270.
6. Eric, V. Denardo, 2003. Dynamic Programming: Models and Applications. Dover Publications, pp: 240.
7. Roberts, C., 1965. Dynamic programming in processes of chemical technology and methods of control / C. Roberts. M: World, pp: 480.
8. Roberta, S. Russell and Bernard W. Taylor, 2005. Operations Management: Quality and Competitiveness in a Global Environment. Wiley, pp: 832.
9. Gavrilovskaya, S.P., 2009. Analyze of methods of distribution of complex costs at the enterprises of oil refining / S.P. Gavrilovskaya and O.V. Domozhirova // Messenger of the Belgorod university of consumer cooperation. Series: economic sciences. Belgorod: BUPK, 3: 263-267.
10. Michael, E. Porter, 1998. Competitive Advantage. The Free Press, pp: 580.