

Научная сессия

DOI: 10.15593/2499-9873/2022.2.04

УДК 658.5

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ФОРМИРОВАНИЕ МЕТОДОЛОГИИ СТРАТЕГИЧЕСКОГО И ОПЕРАТИВНОГО УПРАВЛЕНИЯ ПРОМЫШЛЕННЫМИ ПРЕДПРИЯТИЯМИ В УСЛОВИЯХ ГЛОБАЛЬНОЙ НЕСТАБИЛЬНОСТИ

Крайнее обострение военно-политической нестабильности в мире, введение Соединенными Штатами Америки и другими странами Запада огромного количества разнообразных санкций против России создало для промышленных предприятий нашей страны весьма сложные условия для ведения бизнеса. В связи с этим особенно важными представляются вопросы формирования методологии стратегического и оперативного управления промышленными предприятиями, которым необходимо обеспечить выживание и дальнейшее развитие, несмотря на вредоносное воздействие западных государств и сложнейшие проблемы с ресурсным обеспечением производств, а также реализации продукции за границами Российской Федерации.

Рассматриваются основные направления развития научной мысли в области стратегического и оперативного управления промышленными предприятиями, в том числе в современных условиях, характеризующихся не только военно-политическим обострением ситуации в мире, но и во многом связанным с этим процессом возникновением экономических кризисов в крупнейших регионах Америки и Европы.

Предложен новый агрегированный алгоритм управления промышленными предприятиями как на стратегическом, так и на операционном уровне, основанный на математических моделях и методах с учетом особенностей современных отраслевых рынков. Отмечается также, что современная мировая экономика подвержена циклическим явлениям в силу самой природы капиталистических отношений, а не только из желания западного мира уничтожить Россию и ее мощный промышленный потенциал.

Также представлен ряд разработанных авторами математических моделей для оценки производственной эффективности промышленных предприятий как для вариантов функционирования производственных компаний в условиях стабильной внешней среды и повышенного спроса на продукцию предприятий, так и для условий их работы в периоды кризисных явлений. Наиболее актуальными сегодня являются модели выбора стратегических решений в условиях глобального кризиса.

Таким образом, предложена методология подготовки принятия управленческих решений руководством промышленных предприятий, обеспечивающая минимизацию затрат на производство и реализацию готовой продукции, а также целесообразность технического перевооружения предприятиями в различные периоды функционирования мировой экономики. Сообщается также о том, как предложенная методология стратегического и оперативного управления промышленными предприятиями в еще совсем недавнем прошлом позволяла российским производственным компаниям достичь достаточно высоких показателей работы и конкурентоспособности на международном уровне.

Ключевые слова: стратегическое управление, оперативное управление, глобальная нестабильность, промышленное предприятие.

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FORMATION OF THE METHODOLOGY OF STRATEGIC AND OPERATIONAL MANAGEMENT OF INDUSTRIAL ENTERPRISES IN THE CONDITIONS OF GLOBAL INSTABILITY

The strong aggravation of military and political instability in the world, the introduction by the United States of America and other Western countries of a huge number of various and unjustified sanctions against Russia created very difficult conditions for doing business in our country's industrial enterprises. In this regard, the issues of forming a methodology for the strategic and operational management of industrial enterprises, which need to ensure survival and further development, despite the harmful effects of Western states and the most difficult problems with resource support for production, as well as sales of products outside the Russian Federation, are of particular importance.

The article discusses the main directions of development of scientific thought in the field of strategic and operational management of industrial enterprises, including in modern conditions, characterized not only by the military-political aggravation of the situation in the world, but also in many respects related to these processes, the emergence of economic crises in the largest regions of America and Europe.

The authors propose a new aggregated algorithm for managing industrial enterprises, both at the strategic and operational levels, based on mathematical models and methods, taking into account the characteristics of modern industry markets. It is also noted that the modern world economy is subject to cyclical phenomena due to the very nature of capitalist relations, and not only from the desire of the Western world to destroy Russia and its powerful industrial potential.

The article also presents a number of mathematical models developed by the authors for assessing the production efficiency of industrial enterprises both for the options for the functioning of manufacturing companies in a stable environment and increased demand for enterprise products, and for their working conditions during periods of crisis. The most relevant today are the models of choosing strategic decisions in the context of the global crisis.

Thus, the paper proposes a methodology for the preparation of managerial decision – making by the management of industrial enterprises, which ensures the minimization of costs for the production and sale of finished products, as well as the feasibility of technical re – equipment by enterprises in various periods of the functioning of the world economy. It is also reported how the proposed methodology for the strategic and operational management of industrial enterprises in the quite recent past allowed Russian manufacturing companies to achieve fairly high performance and competitiveness at the international level.

Keywords: strategic management, operational management, global instability, industrial enterprise.

Introduction

The changes taking place in the world in recent years, associated with an increase in global instability (military-political, social, economic, etc.), have led to a deterioration in cooperation between countries in the field of

trade, development of large-scale projects and other constructive activities. At the same time, all this largely contributed to the huge population masses migration to European countries, Turkey, Russia, etc. Epidemiological processes have shaken the global world even more in particular the pandemic caused by the coronavirus has so worsened the population situation in many countries and regions of the world that a return to the previous state of international cooperation is unlikely to occur.

Under such conditions, the wide variety activities of organizational and production structures have become significantly difficult. This has particularly affected Russian industrial enterprises that sell their products abroad. The increased competition between the largest products producers sold on international markets, as well as the sanctions imposed by the United States of America and its allies against Russian manufacturers, have made the functioning of domestic industrial enterprises an extremely complex process, associated with a lot of different risks.

In such circumstances, Russian industrial enterprises need to improve their efficiency so that they can maintain their competitiveness in the international arena and create economic and technological basis for further successful development.

It is known that achieving more efficient work of a company separate division does not make the whole company effective. In this way, the management of the entire company should be built in modern conditions not on solving a set of local problems, but on achieving a strategic goal through the restructuring of all divisions. That is why the world's leading companies are trying to form at first a comprehensive vision of their development and then proceed to the implementation of strategic management. A global vision allows such companies to survive the phases of recession in world markets due to measures taken during good economic conditions periods. In times of financial and economic crisis, the emphasis in the management of industrial enterprises is made on the methods and mechanisms of management according to such concepts as – "LEAN" and "theory of constraints" [1–3].

Based on the foregoing, the main emphasis in the management of industrial enterprises should be based on the analysis of production factors it is they that create the basis through which the enterprise can survive in a crisis. Moreover, the main factor in such conditions can be considered the enterprise management system, namely those approaches, methods and management mechanisms that underlie it. Thereby, management methods in

crisis conditions become the main factors in the survival of the enterprise and completely overshadow the role of all other factors of production that gave competitive advantages to the enterprise during periods of economic growth. In a crisis, it is especially important what complex information system an industrial enterprise uses to manage labor, material and information resources. This system must successfully implement the basic functions of strategic analysis and forecasting, as well as the tasks of flexible operational management of the enterprise.

Only a management complex that includes management mechanisms capable of adequately responding to global challenges can provide effective management of business processes at an enterprise. At the same time, the integrity of the management of the entire enterprise should not be violated. A comprehensive information and analytical enterprise management system is built using modern mathematical models, methods and technologies. All this allows you to create a “framework” of the enterprise, on which you can build effective strategic and operational management [4; 5].

The solution to this crucial problem should include the creation of new adequate approaches, methods, models and technologies of management and the development of large domestic industrial enterprises and corporations.

I. Formation of the basic conceptual principles of strategic and operational management

An analysis of the approaches and methods of strategic and operational management of industrial enterprises used in practice, as well as the effectiveness of these methods, shows that the vast majority of them do not allow modern production companies to carry out effective management that ensures their competitiveness in international markets.

In addition, the changes noted in the introduction that have occurred in recent years in the business environment for Russian industrial enterprises have made it possible to say that shareholders and managers of production companies need adequate approaches, concepts and methods to improve the quality of strategic and operational management. The absence of such approaches will not allow the industrial enterprises of our country to maintain (and even more so to improve) their positions in international markets. Today, ensuring the efficient operation of Russian industrial enterprises is becoming a much more difficult task than that of their foreign competitors.

As a result, the solution to the problem of strategic and operational management of enterprises and corporations in Russia should include adequate concepts, methods and technologies.

Before setting out the main provisions of the concept of strategic and operational management of industrial enterprises in the context of global instability, let us make the following remark [6]. The evolution of management approaches, which began with scientific schools (scientific management, administrative management, human relations, behavioral sciences, quantitative analysis) and approaches to management (process, system, situational), ending with a variety of modern approaches, concepts, methods and algorithms for enterprise management are aimed at increasing efficiency of activities due to the improvement of technologies for preparing decision – making. This direction remains a priority in the formation of effective strategies for the development of industrial enterprises, as well as the implementation of operational management.

The development of directions of Western management in scientific literature has been covered much more fully than Russian, the emergence of which began at the beginning of the XX century [7]. At the beginning of this period, institutes of the scientific organization of labor were actively created in Soviet Russia, in which essentially the same management processes were studied as in the largest foreign countries [8; 9]. Since then industrial enterprises had already become state property, the main ideas and developments for their management were formed in the course of centralized planning and management of various industries, as well as increasing the productivity of manual labor, its rationing, etc. However, there were no coherent, scientifically based concepts for improving the effectiveness of strategic management of industrial enterprises in that era. The functions of strategic management of the country's enterprises in the sectoral context belonged to the State Planning Committee, as well as to individual ministries, which in the Soviet Union by the beginning of the 1980s were created in an excessively large number [10]. By the time of the decline of socialism in the USSR, there were already about a hundred ministries in the government of the country, and among them, there were several ministries of the metallurgical profile, several of the machine – building profile, and so on by industry group [11]. As a result, the strategic management of individual industrial enterprises in our country began to be seriously discussed only after the restoration of capitalism, which is, starting from the 1990s.

Moreover, since the new Russia in those years was under the influence of the West, the developments of domestic scientists in the field of scientific management (including strategic management of industrial enterprises and organizations) repeated the scientific ideas and approaches of well-known Western schools and their most prominent representatives.

It is worth mentioning several modern works of Russian scientists in the field of strategic management of industrial enterprises [12–15].

The authors of this article have also studied the issues of strategic and operational management of industrial enterprises for a number of years [16].

By now, many owners and managers of Russian industrial enterprises have fully realized that the creation of a strategic and operational management system adequate to the conditions of global instability is a vital necessity for production companies. Thereby, today the scientific basis of strategic and operational management in Russia is in urgent need of rethinking and further development.

It should also be noted that Western theoretical developments in the field of strategic and operational management of enterprises and organizations, as well as Russian ones, go back to the beginning of the last century, during which they were developed and supplemented.

Among the world-famous theorists of Western management, whose contribution to its development is still relevant today, it is impossible not to mention the names of D. Aaker, R. Ackoff, I. Ansoff, St. Beer, T. Peters, P. Drucker, M. Porter, D. Womack, P. Gaughan, R. Johnson, R. Koch, H. Mintzberg, W. Rice-Johnson, P. Senge, A.-W. Scheer, J. Sheldrake, etc. [17].

Today it is obvious that the fashion for the use of certain ideas, approaches, concepts and other theoretical developments in the strategic and operational management of enterprises and organizations has constantly changed depending on the emergence of new approaches and concepts created by foreign scientific schools in the field of management. The emergence of each new school and approach to management, as well as other conceptual developments of this kind, received widespread advertising in the Western scientific literature, and consulting firms in this regard attracted many new clients and earned good money with their help.

It is important to understand that the development of management theory took place over a very significant time. Therefore, the scientific ideas, positions and results of those who participated in this process and con-

tributed to the modern theoretical heritage of management science should be perceived and evaluated taking into account the historical features, business conditions of that time, as well as taking into account the goals and objectives set by certain management theorists and practitioners.

The study of foreign developments in the field of strategic management shows that today the most common and proven methods for analyzing the strategic position of an enterprise are:

- SWOT analysis, STEP Analysis (analysis of the macro-environment spheres: social, technical, economic and political);
 - Analysis of the “field of forces” by I. Ansoff;
 - Allocation of competitive forces by M. Porter;
 - Comparison of growth rates and market share – BCG matrix;
 - Evolution analysis method – Hofer/Schendel model;
 - Industry attractiveness analysis – Shell/DPM model;
- Comparison of market attractiveness and competitiveness – GE/McKinsey model.

Experts in the field of production management in the West are actively promoting these developments in the process of consulting for industrial enterprises and corporations. However, if for foreign manufacturing companies these management technologies are possible and allow achieving positive results, then for Russian industrial enterprises they are often ineffective [16]. Moreover, the theoretical and methodological substantiation of the overwhelming majority of developments in the field of Western industrial consulting, various concepts and recommendations for the development of companies and corporations in foreign scientific literature are presented, unfortunately, only at the verbal level. A significant part of them, by their very nature, have never gone and to this day do not go beyond the framework of mostly banal advice to various managerial links in companies. In this way, all technological, technical, informational, and often organizational and methodological aspects of increasing the efficiency of industrial enterprises and corporations remain outside the aforementioned developments.

Thereby, the main conclusion from the above is the following: the application of theoretical positions and developments in the field of production management, widely presented in foreign scientific literature, as well as the ideas of domestic theorists that repeat them, for Russian companies can hardly provide an increase in the efficiency and competitiveness of their activities.

Shareholders and heads of Russian industrial enterprises should understand that the work of their companies is complicated not only by the influence of factors of external conditions of global instability, but also by the peculiarities of the functioning of industrial enterprises and organizations in Russia, which are very specific and largely differ from the established Western practices. In Russia, we have a different mentality, different criteria for the success of production, economic and financial activities from the West, which do not always coincide with foreign ideas about methods and means of achieving goals in competition, technical re-equipment of production facilities, information support for business, payment and incentives for personnel, etc.

Perhaps that is why, even if some Russian industrial enterprises follow the recommendations of Western theorists and business practitioners as much as possible, this does not always give a positive result in the strategic and operational management of these companies.

In modern conditions of conducting production activities, authoritarian technologies of strategic and operational management of enterprises, which are mainly used in the past in Russia, are hardly acceptable, which are based on the following basic provisions and principles:

- The enterprise management system is built in such a way that all more or less significant decisions can be made only by its head (top manager);
- The company should create such a procedure for providing data to the company's management, in which it is absolutely unacceptable to distort information about the current state of affairs;
- The company's desire to achieve good results in strategic and tactical management is primarily associated with the provision of total control by the chief executive over financial flows, resources, documents, information bases, warehouse stocks, sales system, external relations, etc. Such control should to be concentrated specifically with the top manager of the company, and not with any of his deputies or other high-ranking officials in the structure of the company, since the “dilution” of leadership, and hence responsibility, can significantly reduce the effectiveness of management [16].

In the current conditions of global instability, the strategic and operational management of industrial enterprises in our country should be focused on taking into account the impact of global socio-economic processes, the emerging international market conditions and market dynamics, the specifics and peculiarities of doing business in certain regions.

Certain industrial enterprises, large manufacturing corporations or holdings, when forming a strategy for their future development, as well as tactics for achieving it and operational management of companies' activities, are guided, of course, by their experience gained during the years of Russian reforms [16]. However, the business environment that has changed over the past few years in a certain way neutralizes this experience, making it, perhaps, not quite suitable for the development of such strategies (as well as algorithms for managing the current activities of industrial enterprises) in the currently emerging situations of uncertainty. Moreover, both in the formation of forecasts of market development, the behavior of competitors, etc., and in determining the set of steps in planning and managing the company's activities.

In modern, very difficult business conditions, successful management of the activities of industrial enterprises and corporations should be based on the awareness of their leaders that in any production structures today it is impossible to consider management algorithms differentially, that is, according to certain areas of company activity. It is possible to ensure effective management of industrial enterprises and corporations only on condition that management, information, production, financial and economic and all other technologies, including logistics, marketing research, etc. should be considered in conjunction and from the standpoint of achieving the goals set before the companies and criteria for the effectiveness of achieving the latter. Only with this approach does it become possible to ensure the balanced development of companies based on the creation of appropriate advantages in their struggle with competitors.

You must also consider that in preparing the decisions on the operational management of industrial enterprises planning horizon now shrunk to a very short time periods. In these conditions, industrial enterprises need to use such local management models that make it possible to achieve the most acceptable results in the practical preparation of the formation of management decisions.

Formation of the concept of strategic and operational management of Russian industrial enterprises in the context of increasing various kinds of instability and sanctions from Western countries should include all the previously mentioned considerations that allow improving the processes of developing long-term and short-term forecasts, as well as the justification of the relevant management decisions within these forecasts.

The following is an aggregated algorithm for strategic and operational management of industrial enterprises, which allows, at the methodological level, to clarify the procedures for developing management decisions in the process of production activities of companies.

II. Aggregated algorithm for strategic and operational management of industrial enterprises

The presented algorithm includes the following aggregated blocks for the preparation and adoption of managerial decisions for the strategic and operational management of industrial enterprises.

1. At the beginning of work on the creation of an integral paradigm of strategic and operational management of an industrial enterprise, it is necessary to analyze the existing operational, tactical and strategic approaches, methods and models of management functioning at the enterprise, to identify “bottlenecks” that reduce the efficiency of its work on different directions.

2. In accordance with the wishes of the main shareholders of an industrial enterprise, strategic priorities, goals and objectives of its development are determined. In the course of such work, the main shareholders of the company, together with its management, formulate their vision of what an industrial enterprise should become in the future. At the same time, it is important to reflect the totality of various kinds of changes for all divisions, departments, workshops, warehouses, transport and other infrastructural elements of the enterprise in all areas of activity [16]. In the course of such work, the following should become clearer: the perspective dynamics of the development of the logistics of an industrial enterprise; modernization of the technical park; the use of new industrial technologies; improvement of the existing or creation of a new integrated information and analytical system for preparing managerial decision-making at the enterprise. The owners of an industrial enterprise should be able to express their vision of what changes in the enterprise are advisable to carry out from their point of view. This may also concern what changes will occur with the quality of products, the use of available sources of raw materials, as well as the dynamics of sales markets, etc. In this way, there can be formed the basis of management paradigm proposed industrial enterprise.

3. Within the framework of the ideology of doing business proposed by the shareholders and managers of the enterprise, new conceptual approaches, adequate methods and complexes of mathematical models should

be created to improve the algorithms and technologies of strategic and operational management of an industrial enterprise. And also to formulate the main tasks for improving the decision support system in the process of managing various areas of activity and divisions of the company. All these efforts should be aimed at increasing the efficiency of the industrial enterprise and ensuring its competitiveness not only in the near, but also in the distant future.

Formation of strategy of industrial enterprise development can be carried out based on several scenarios. When choosing the most acceptable scenario for the development of a company, the criteria may be as follows:

- The opportunity to make the best use of their competitive advantages;
- Availability of a set of the most qualified specialists for the successful implementation of the strategy;
- Provision of the scenario under consideration with all types of resources;
- Minimization of investments in updating the material base;
- Justification of the introduction of new production technologies while the profitability of the enterprise remains unchanged;
- Possible reduction by the enterprise of the harmful impact of emissions on the environment.

The choice of the company's development strategy should be based on a comparison of the feasibility studies of the developed scenarios.

4. Among the most effective, giving significant practical results, developments on the strategic and operational management of industrial enterprises, it is advisable to use the relevant methodologies that have proven their practical value, created by the authors of this article [16; 18].

As part of these methodologies, a number of new mathematical models were developed [18], some of which are listed below:

- Comprehensive assessment of the financial condition and economic activity of an industrial enterprise;
- Management of material resources of an industrial enterprise, while ensuring its economic and environmental priorities;
- Optimization of the delivery of goods from producers of raw materials;
- Development of an industrial enterprise in new territories;
- Improving the efficiency of human resource management in enterprises by improving the systems of remuneration and incentives for employees;

- Formation of the production of industrial enterprises plan on output;
- Planning of preventive maintenance of fixed assets of an industrial enterprise, etc.

It is advisable to carry out the process of operational management of an industrial enterprise using a model developed by the authors within the framework of the predictive-adaptive approach, a detailed description of which is presented in [18].

A mathematical model for determining the selling price of products, which guarantees the break-even of the main activity of an industrial enterprise with a given probability [19], also supplements this adaptive model.

5. For the successful implementation of the above points, it is necessary to bring the company's structure into line with the changed business conditions, and, if necessary, to radically reform it. The structure of an industrial enterprise created in this way should best meet the requirements of effective management of the company within the entire management vertical. In such a structure, all unnecessary management links should be eliminated, so that any orders and management commands reach the final performers as quickly as possible (without unnecessary intermediaries). At the same time, the main management functions of the company's structural divisions should organizationally ensure the implementation of the main goals and objectives of the enterprise. In addition, the reduction of unnecessary management links in the management structure of the enterprise provides additional savings in financial resources.

As shown by the research of the authors, the construction of a structural scheme for managing an industrial enterprise should not be carried out using linear or divisional approaches. Matrix-divisional structural schemes are also ineffective for this purpose. For example, in the monographs of the authors O.V. Loginovskiy, A.A. Maksimov “Corporate Governance” (Moscow: Mashinostroyeniye, 2007) discusses in detail the advantages and disadvantages of various structural schemes for managing industrial enterprises and corporations.

6. Shareholders and managers of enterprises need to conduct an operational analysis of performance indicators both for the enterprise as a whole and for its individual divisions.

If the company's performance indicators do not match the planned values during the analysis, the main shareholders and managers of the com-

pany need to adjust the entire set of management methods and models in order to achieve positive dynamics of the company's development in the future.

In this regard, it is possible to raise the question of the expediency of switching to technologies of a new technological order, since the process of technological renewal at industrial enterprises is an expensive event. Shareholders and managers of industrial enterprises should be absolutely sure that in the event of such a transition and updating of equipment, buyers will have demand for products of higher quality and at the same time possibly at a higher price. During periods of economic crises, buyers often prefer to purchase old products that have already proven themselves rather than purchase more high-tech products. Thereby, plans for the transition of an industrial enterprise to technologies within the framework of new technological paradigms should not go beyond the economic possibilities achieved with the existing profitability of production.

The creation of new projects of this kind should be based on an assessment of the capabilities of the facilities available at the enterprise, technological equipment, etc.

In the context of a decline in production in the world and the lack of significant financial resources for the owners of enterprises to transition to the latest industrial technologies, it is advisable for them to make a decision to wait for such a transition and implement it only in case of economic feasibility and acceptable risks. Project management in the enterprise can be successfully carried out using modern methodologies, for example, presented in [18].

7. The head (top manager) of an industrial enterprise or corporation is obliged to offer it to its main shareholders and without fail to approve their system of preparation and adoption of basic managerial decisions on the development of the company, as well as the operational management of its work. Such work cannot be effectively carried out without a developed information and analytical system for supporting management decisions, which is an integral part of an integrated information and computing system of an industrial enterprise or corporation. At the same time, the mathematical models and methods used in the process of analyzing various indicators of the company's performance, as well as other calculations, must meet the requirements of analysts and decision-makers at all stages of preparing these decisions. Thereby, the applicability of certain models and methods must be agreed with the decision-maker.

Since in any modern industrial enterprises and corporations today there is a more or less developed set of information systems for various purposes that can function locally, or within the integrated information and computing system of a company, it is important that the performance indicators of these systems do not contradict each other. Moreover, they could be interconnected into a single integral complex of enterprise activity management. In addition, the inability for the company's management to receive consistent information from its divisions, in which such systems operate, largely negates the benefits of their operation.

Particularly serious difficulties in the development of management decisions for company managers may arise in the case of using foreign ERP and other information systems at the enterprise, since often the latter do not include calculation, analytical and other modules necessary for the company's management (for example, modules for the movement of materials, semi-finished products, etc. products in production workshops). In such cases, the company has to order the creation of these modules the Russian IT-developers.

The development of an effective decision-making preparation system in the company should go in parallel with the development and improvement of information and communication infrastructure, the introduction of new or modernization of existing computer systems (expert, information and analytical systems, etc.) operating at the enterprise.

If the company does not create a modern information and computing infrastructure, which should be based on an automated management system that is adequate to the requirements of users and the level of business processes, then it will be extremely difficult for such a company to compete not only in international, but also even in domestic markets.

We must not forget that under the current conditions, the use of foreign equipment, computers, foreign software as part of the company's information and computing infrastructure does not make it possible to guarantee that this equipment will not fail or stop functioning altogether in the event of a deterioration in military the political situation in the world.

The development of the company's information and computing infrastructure and information and analytical systems for preparing decision-making can be successfully carried out on the basis of methodological and technical developments presented in [16; 18].

8. The process of creating a management strategy for an industrial enterprise, as well as managing its current activities [16; 18] should include:

- The formation of an analytical forecast for the development of organizations of competitors, suppliers and consumers of products, as well as the dynamics of various environmental factors affecting the enterprise (moreover, both direct and indirect);
- Creation of an effective system of human resource management, selection and placement of personnel;
- Ensuring a thoughtful and consistent distribution of functions, rights and obligations between and within the divisions of an industrial enterprise.

III. Industrial management mathematical model in conditions of fluctuating demand for products

The modern economy is subject to a cyclical change in demand [20; 21]. With a low level of fluctuation in demand and supply in world markets, the objective function (Φ_1) of the efficiency of an industrial enterprise can be represented by the function of maximizing sales profit (Π^T) for the period [23; 24]:

$$\Phi_1 = \Pi^T \rightarrow \max. \quad (1)$$

Profit from sales for the period, T , in turn, is calculated as:

$$\begin{aligned} \Pi^T = & \sum_f (I_f^T \cdot C_f^T) - \\ & - \sum_f \left(I_f^T \cdot \left(\sum_n S_{fn}^{ET} + \sum_n \sum_m S_{fmm}^{MT} + \sum_k \sum_n Z_{fkn}^T \right) \right) - S^{OT}, \end{aligned} \quad (2)$$

where C_f^T – the cost of products of the f -th brand, released in the time period T , thousand rubles.

I_f^T – the volume of output of finished products of the f -th brand for the period of time T , τ ;

S_{fn}^{ET} – the cost of electricity E per unit of output of finished products for the release of the f -th brand of products in the n -th unit for the period of time T , thousand rubles.

S_{fjm}^{MT} – the materials costs M for m -th material per unit of output for the production of the f -th brand in the n -th unit for the period of time T , thousand rubles.

Z_{fkn}^T – the cost of wages for workers involved in the production of products, per unit of the issued n -th brand of the f -th brigade at the k -th unit of the enterprise for the period of time T , thousand rubles.

S^{OT} – total fixed costs of an industrial enterprise for the period T .

Therefore, in a stable external environment, the company must maximize profits, first of all, by increasing production volumes, and secondly, to reduce variable and fixed production costs (such as management costs, security costs). enterprises, environmental payments, for damage to the environment, etc.) [24].

In the event of a need for production at the company's production, it is engaged in increasing volumes, adapting to market demands. The decision to increase production is of an operational nature, and the enterprise takes responsibility for covering the environment with the environment and the production load of the enterprise. The conclusion to calculate the profit of the enterprise can be drawn as follows:

$$\begin{aligned} \Pi^T = & \sum_f \left((I_{f\,dop}^T + I_{f\,dog}^T) \cdot C_f^T \right) - \\ & - \sum_f \left((I_{f\,dog}^T + I_{f\,dop}^T) \times \left(\sum_n S_{fn}^{ET} + \sum_n \sum_m S_{fjm}^{MT} + \sum_k \sum_n Z_{fkn}^T \right) \right) - S^{OT}, \end{aligned} \quad (3)$$

where $I_{f\,dog}^T$ – the output volume of the f -th brand of products, which the enterprise must produce in accordance with contractual obligations for the period of time T , τ ;

$I_{f\,dop}^T$ – additional volume of output of the f -th brand of products for a period of time, T , τ .

Due to the fact that in favorable periods of time, fixed costs (S^{OT}) remain unchanged, an increase in production will lead to an increase in profits, provided that the profitability of the f -th product brand was a positive value.

The procedure for maximizing profits should be implemented subject to a number of restrictions, in particular, the volumes of output of the f -th

brand of products should not be less than the volumes stipulated by the concluded contracts; production volumes cannot exceed the technological capabilities of the enterprise and other limitations specific to a specific industrial enterprise.

In the event of a fall in demand for manufactured products, due to crisis phenomena in the global economy, the target of the enterprise is not to maximize profits, but to minimize production costs [25]. Then the objective function can be written in the following form:

$$\Phi_2 = \min F(S^{ET}, S^{MT}, Z^T, P_d^T), \quad (4)$$

where S^{ET} – energy costs for the period of time T , thousand rubles.

S^{MT} – material costs for the period of time T , thousand rubles.

Z^T – labor costs for the period of time T , thousand rubles.

P_d^T – unregulated losses over a period of time T , caused by the influence of crisis phenomena in the economy, thousand rubles.

In other words, the objective function Φ_2 will take the following form:

$$\Phi_2 = \sum_f \left(I_f^T \cdot \sum_n (S_{fn}^{ET} + S_{fnn}^{MT} + Z_{fkn}^T) \right) + P_d^T \rightarrow \min, \quad (5)$$

Enterprise activity evaluation for the period T is carried out according to the analysis of the completion of all costs for this period:

$$\Phi_2^o = \sum_T (S^{ET} + S^{MT} + Z^T + P_d^T). \quad (6)$$

During this period, one possible management solution is to reduce the output of finished products, which in some cases leads to a reduction in total costs.

In this way, during significant fluctuations period in demand for manufactured products, in conditions of economic crises, the objective function effectiveness assessing of an industrial enterprise is the total costs reduce of both production and non-production. In this case, it is extremely important

for the shareholders of the company to identify their own time forecasts of possible crisis situations in order to make decisions on risk management. That will allow the enterprise to adapt for changes in environmental factors.

IV. Conclusion

Foreign and domestic experience in managing enterprises and organizations, scientific research on strategic and operational management of companies in recent years in modern conditions of global instability no longer allow managing their development with a sufficient degree of efficiency. In the new conditions of doing business (growing political, economic instability, sanctions, etc.), updated approaches, concepts or mechanisms for the formation of the development of industrial enterprises and corporations are required.

The aggregated algorithm of strategic and operational management proposed by the authors can significantly improve many classical approaches to the management of industrial enterprises by taking into account the main trends that have developed in modern markets. Owners and managers of enterprises, based on the proposed algorithm, can create mechanisms for strategic and operational management that are adequate to modern business conditions.

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Библиографическое описание статьи согласно ГОСТ Р 7.0.100–2018:

Formation of the methodology of strategic and operational management of industrial enterprises in the conditions of global instability = Формирование методологии стратегического и оперативного управления промышленными предприятиями в условиях глобальной нестабильности / О. В. Логиновский, А. В. Голлай, А. Л. Шестаков, К. А. Коренная. – текст : непосредственный. – DOI: 10.15593/2499-9873/2022.2.04 // Прикладная математика и вопросы управления = Applied Mathematics and Control Sciences. – 2022. – № 2. – С. 73–94. – Ст. на англ. языке.

Цитирование статьи в изданиях РИНЦ:

Formation of the methodology of strategic and operational management of industrial enterprises in the conditions of global instability / O. V. Loginovskiy, A. V. Hollay, A. L. Shestakov et al. // Прикладная математика и вопросы управления. – 2021. – No 2. – P. 73-94. DOI 10.15593/2499-9873/2022.2.04

Цитирование статьи в references и международных изданиях

Cite this article as:

Formation of the methodology of strategic and operational management of industrial enterprises in the conditions of global instability. *Applied Mathematics and Control Sciences*, 2022, no. 2, pp. 73–94. DOI: 10.15593/2499-9873/2022.2.04

Финансирование. Исследование не имело спонсорской поддержки.

Конфликт интересов. Авторы заявляют об отсутствии конфликта интересов.

Вклад авторов. Все авторы внесли равный вклад в подготовку публикации.

Поступила: 11.05.2022

Одобрена: 03.06.2022

Принята к публикации: 03.06.2022