



MODEL OF ENSURING ECONOMIC SECURITY IN MECHANICAL ENGINEERING

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ABSTRACT

Industry as a strategic sector of the economy is an important structural element of the economic security of the state, whose performance indicators are a priority for determination of the level of economic development of the country. It forms the foundation for research and technological transformation, economic growth, and social progress in society. The formation of tools for ensuring the economic security of the state based on the improvement of the machine-building complex and the elimination of threats to economic security involves: a) the creation of a centralized system for ensuring the economic security of the state from the standpoint of mechanical engineering; b) the identification of structural imbalances containing a threat to the economic security of the state; c) the development of tools to ensure the economic security of enterprises by influencing the structural imbalances in mechanical engineering at all levels.

Keywords: mechanical engineering, economic development, economic efficiency, economic security

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INTRODUCTION

Mechanical engineering is traditionally considered the basis of the national economy and plays a leading role in creating the material and technical basis for all of its industries. The level of development of mechanical engineering is considered one of the important indicators of the economic condition of the country and one of the main indicators for assessing its economic security. Its exclusive role is to implement innovative, science-intensive projects in all sectors of the economy and is defined in the concept of a nationwide target economic program for the development of industry, where it was noted that the pricing environment for the main export positions and the demand for products of the engineering industry have a decisive influence on the situation in the industry (Fig. 1).



In 1990, the share of engineering products was 32% of GDP (State Statistics Service of Ukraine, 2021). However, the domestic engineering industry continues to decrease in parallel with its scientific and technical degradation.

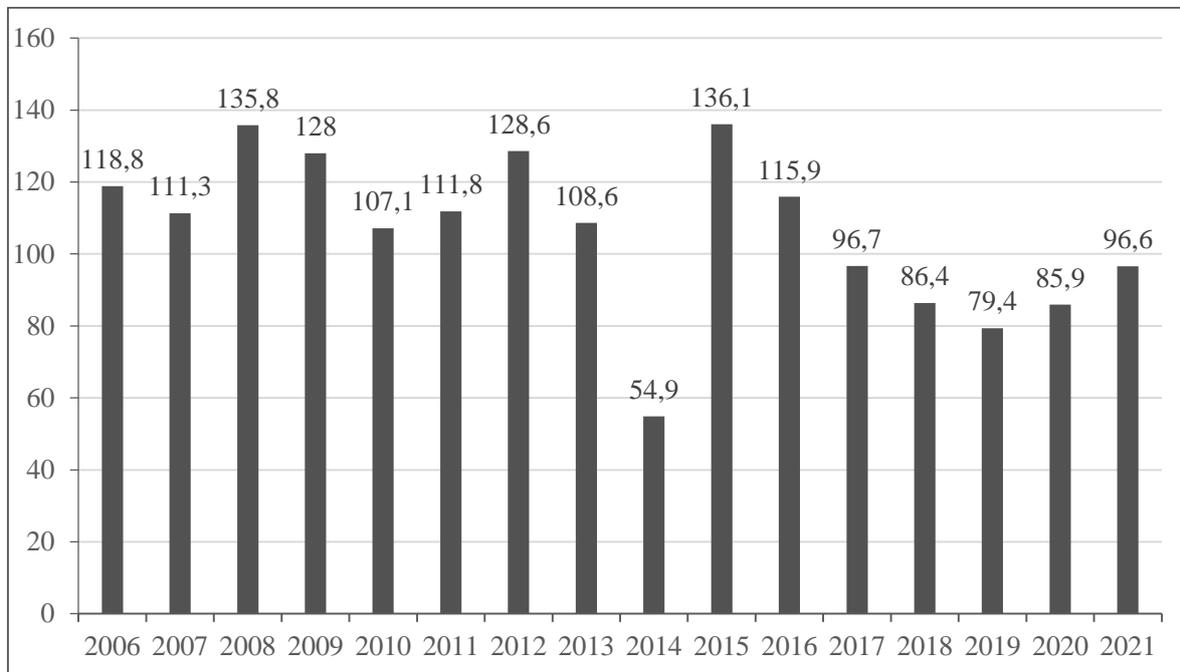


Figure 1. Index of industrial production of mechanical engineering of Ukraine in 2006 - 2021 (in % to the previous year) (State Statistics Service of Ukraine, 2021).

The management of the economic security of the machine-building complex ensures the effectiveness of the activities of machine-building enterprises in the current period of their operation and in the long term. At the same time, effective management in any field of activity can be carried out only when its integral system is formed, designed to perform the main tasks of management. Therefore, a necessary condition for ensuring the functioning of machine-building enterprises in a market economy is the allocation of vectors for improving the economic security of the country's machine-building complex.

Management of economic security at the strategic, tactical and operational levels makes it possible to prevent the destructive impact of changes in the factors of the internal and external environment of the enterprise and prevent their decrease to a level within which the machine-building enterprise cannot function without a threat to the stability of its activities.

At the same time, the problem of choosing a priority among certain vectors of enterprise development and matching the strategy to internal production processes, namely: the policy of managing the renewal of fixed assets, technical and technological re-equipment, the introduction of innovations, the system of motivation and development of personnel, and the environmental friendliness of production, is of particular relevance (Chekhovych, 2013).



THEORETICAL BACKGROUND

Modern threats to the activities of enterprises in the machine-building complex cause the promotion of fundamentally new requirements for the construction and organization of the activities of their security systems. In order to counter modern threats and risks, the directions for increasing the level of economic security of enterprises should take into account modern technologies, methods and techniques for actively counteracting all real and potential dangers and risks.

The mechanism for managing the economic security of enterprises of the machine-building complex is created to ensure the correct use of all protective measures in order to minimize (or prevent) the negative impact of hazards, threats, and risks. The management mechanism is manifested primarily with the help of management relations, implemented through the use of appropriate methods based on the principles of management (Chekhovych, 2013). An important part of the stabilization of the economic activity of enterprises in market relations is economic activity in ensuring safety. The development of economic activity is a significant factor in improving the efficiency of economic security. The problems of improving the efficiency of economic activity of enterprises have always been the focus of economists' attention. The theoretical and methodological basis of this study is the main provisions and conclusions formulated in the scientific fundamental works of domestic and foreign economists in the fields of economic and financial analysis, financial management, and marketing. The issues of the functioning of the economic activity of an enterprise are widely covered primarily in foreign scientific literature (Okawa, 2008; Boyk, 2019; Sousa et al., 2021). In Ukraine, these problems are dealt with by such specialists as Rudnichenko et al. (2020), Zhuravlov et al. (2020), Nazarova et al. (2021), Flissack, Dracocrunch (2021).

The purpose of the article is to identify the main ways to improve the economic activity of enterprises in the context of a model for ensuring economic security in mechanical engineering.

RESULTS AND DISCUSSION

The problems of improving the economic security of the machine-building complex have always been quite relevant, but since 2009, that is, after the end of the global financial crisis, there has been an urgent need to form new vectors for ensuring the economic security of the machine-building complex in order to take into account the influence of the maximum number of destabilizing factors in the future. This will allow the development of a set of measures to achieve a high level of competitiveness for business entities. Only systemic provision of the economic security of the machine-building complex will contribute to the development of enterprises and the achievement of their planned indicators (Fig. 2). In the case of the implementation of systemic economic security, the components of engineering enterprises will be able to stabilize the level of economic security, which will manifest itself in countering the effects of destabilizing factors and which will achieve economic efficiency, that is, get a positive result from the invested resources and the implementation

of actions. At the same time, it will help enterprises obtain competitive advantages and form a stable position in the market.

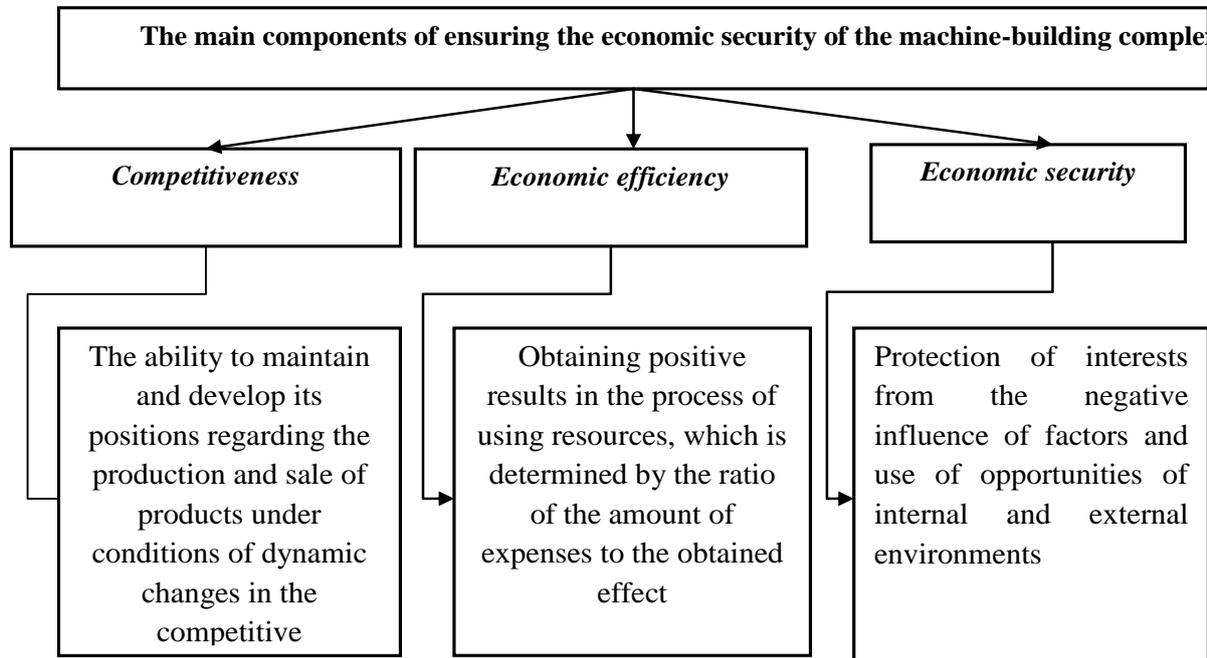


Figure 2. The main components of ensuring the economic security of the machine-building complex

Source: Chekhovych, 2013

The entire process of systemic ensuring the economic security of engineering enterprises is built on the activities of economic entities to determine the manifestations of destabilizing factors and develop measures to eliminate them, minimize their impact, or prevent the action of these factors (Chekhovych, 2013).

Accordingly, on the basis of the collected and analyzed information, the subjects of ensuring the economic security of enterprises in the machine-building complex should form the strategy and tactics of the enterprise to increase its level of economic security. Strategic planning is understood as a process of modeling the effective activity of engineering enterprises for a certain period of operation with the definition of their goals and their changes in an unstable market environment and finding a way to implement these goals and objectives in accordance with their capabilities.

The strategic plan helps to form a holistic view of the organization and its goals and determines priorities. It allows you to increase the efficiency of using the strengths of a machine-building enterprise and to coordinate its development with ongoing changes in the environment.

Despite the rather weighty advantages of strategic planning, domestic machine-building enterprises practically do not carry it out. This is largely due to the fact that the leaders of such business structures do not realize their advantages and do not have experience in their implementation. A specific factor complicating strategic planning is the instability of the external environment. It leads to the fact that strategic planning takes



into account information about the state of the internal environment while the state of the external environment is ignored (Chekhovych, 2013)..

The process of systematic ensuring the economic security of enterprises in the machine-building complex is based on the activities of economic entities and consists of determining the manifestations of destabilizing factors and the formation of measures to eliminate them, reduce their influence or avoid the action of these factors. Taking this into account, the initial component is the activity of the subjects ensuring the economic security of enterprises in the machine-building complex. They form the concept of economic security for enterprises of the machine-building complex, where the distribution of functions between them is clearly carried out and a list of goals is drawn up that is intended to be achieved in the process of implementing the above functions. The work of the subjects on the comprehensive provision of economic security of enterprises of the machine-building complex begins with the collection of information and diagnosis of the influence of destabilizing factors and opportunities that create the internal and external environment. Comprehensive provision of economic security for enterprises of the machine-building complex requires thorough information support for assessing the state of the internal and external environments, making decisions at the appropriate level in the interests of the functioning of the enterprise, and reducing the level of uncertainty in the prospects for its activities (Ponomarenko et al., 2019) The algorithm for studying destabilizing factors and the possibilities of the internal and external environments of the enterprise is as follows:

1. Identifying the external and internal environments that affect the enterprise and influence it in the strategic period.
2. Collection of information about these factors
3. evaluation of the information received about each factor of the environmental impact on the enterprise and forecasting the magnitude of the possible impact.
4. assessment of the magnitude of the influence of each factor on the enterprise in the strategic period, resulting in the identification of opportunities and threats to the external and internal environments and strengths and weaknesses (Chekhovych, 2013).

The above mechanism for creating such a system of measures should take into account a number of fundamental features that reflect the high competitiveness of the industry and the possibility of eliminating negative crises in the economy (Yepifanova, 2019). Priority of mechanical engineering's innovative development goalsAny transformation of the industry must take into account the interests and goals of foreign markets. At the present stage, the speed and efficiency of production, implementation, and dissemination of innovations, which is due to the "demand challenge" or "technological push", determine the basic direction for the modernization of the high-tech machine-building complex. Therefore, the content and results of the implementation of this process should acquire an innovative character, and the proposed support measures should focus the modernization of mechanical engineering on innovative development.

Perspective and innovativeness will determine the continuous renewal of the industry based on modern methods and models of economic growth. The best samples of equipment, technologies, and other products



are a criterion for the competitiveness of enterprises in the markets and the effectiveness of modernization processes.

Actually, the standard for the efficiency of modernization of mechanical engineering is a leading comparison base (the best technical, technological, organizational, and other world standards). Thus, the system of measures for the development of modernization should focus on determining the priorities for the development of mechanical engineering with the identification of points of growth or points of application of efforts. The factor that determines the trend of technology modernization is the high wear and tear of production facilities, which cannot provide the required quality, labor productivity growth, and resource-saving. Technological and product modernization is due to the low competitiveness of engineering products. The latest technological innovations are distributed to a limited number of manufacturers and developers who own their own production base, experience, and resources. Accordingly, this requires the development of mechanisms for their implementation. Technological modernization can be achieved through the following channels: investments; acquisition of licenses and patents; creation of integrated innovative forms of business organization; etc. The reaction to technological and product modernization is the modernization of organizational, managerial, monetary, marketing, and other actions.

Therefore, measures to support modernization in mechanical engineering should provide for obtaining long-term results—achieving high business performance and ensuring the long-term life cycle of enterprises, which guarantees their sustainable development. Product, technical, and technological leadership in this industry creates a reserve for maintaining the competitiveness of enterprises, the level of which other market participants often fail to overcome. Therefore, the principle of priority determines the need to support the development of the modernization potential not only of leading enterprises but also of outsider enterprises in the industry market.

Consistency involves considering modernization as an elemental structure, a specific organization with a set of functions in conjunction with other economic phenomena and processes. The concept of consistency is associated with the idea of integrity, which is squeezed out in the provision of mechanical engineering with all the elements necessary for modernization, their qualitative certainty and quantitative sufficiency, connectivity and consistency of interelement relationships or self-organization.

This approach allows considering mechanical engineering not only as an element of a higher level system, but also as an independent system in which various objects and subjects exist as a whole to ensure their purposeful and coordinated activities in the process of modernization in accordance with the functional relationships between them in order to achieving harmonization of interests. In this system, three main elements related to modernization can be distinguished, in particular: the resource provision of modernization, its implementation or organizational design, and the efficiency of using the results obtained. These elements constitute the content of targeted sectoral development programs or modernization programs, the preparation of which should be taken into account in the system of measures to support it (Adamu,Dawha, Kamar, 2015).



Thus, the system of measures to support modernization should help create a basis for the development of innovations, long-term economic growth, and ensure competitive advantages in mechanical engineering. The multivariance and probabilistic nature of modernization, as its important features, require more detailed consideration. There are many options for modernization, namely: from the standpoint of the novelty of the results obtained and the resources (Chekhovych, 2013).

Along with this important vector of improving the economic security of the machine-building complex, we also consider the improvement of the regulatory framework (Kuznyetsova et al., 2021). The current legal system in Ukraine hinders the development of the innovation environment:

- does not change the systemic tax policy in this area, which stimulates the implementation of innovations;
- formed on the basis of conservation and protection, and not the development and use of the capabilities of knowledge-intensive enterprises.

Therefore, it is necessary to develop a number of legislative acts, within which, first of all, it is necessary to determine: the possibilities of tax incentives for the creation, implementation, and dissemination of innovations; opportunities for the commercialization of intellectual property (a system for managing rights to the result of scientific and technical activities; business access to projects that are directly in the field of public administration and responsibility; and the latest technological basis, in particular nanotechnologies).

Support and regulation of modernization in mechanical engineering can be guided by institutional reforms, which are based on the ideas of an effective owner with the nationalization or denationalization of enterprises, the creation of state corporations, the strengthening of the rule of law, the fight against corruption, etc.

At the same time, it is necessary to provide for the formation of state support mechanisms in the legislation aimed at protecting the national producer in the foreign and domestic markets by: developing measures to prevent unfair competition from foreign countries (dumping prices for domestic products); ensuring competitive conditions for a domestic manufacturer in relation to foreign competitors (primarily in lending, providing comprehensive services, etc.); the formation of mechanisms for accumulating budgetary funds allocated to support agriculture, the construction industry, the development of housing and communal services, etc. (Adamu, Dawha, Kamar, 2015).

Consequently, at the state level, the boundaries of industrial, innovation, and scientific and technological policy in the field of mechanical engineering are determined and conditions favorable for the modernization of the complex are created.

At the regional level, when developing measures to initiate the implementation of modernization, it seems necessary to study the possibilities of reindustrialization of the economy and the formation of innovative forms of business, draw up appropriate programs, and prepare territorial laws on innovatively active industrial policy. Of particular relevance is the development of integrated software approaches to the modernization and improvement of the economic security of the machine-building complex. An effective and modern method that enables the achievement of high efficiency in the machine-building complex through the rational use of



installed capacities and available resources is the development of industrial cooperative ties. At the level of local self-government, the policy of modernization in times of crisis should be aimed at the widespread use of the potential of the spatial organization of production based on the cluster integration of production and territorial capabilities. In addition, it is necessary to continue working with business entities to monitor crisis phenomena, re-profiling human resources and compiling anti-crisis programs.

Accordingly, directions for improving the economic security of mechanical engineering should include mechanisms for regulating and supporting the modernization of the mechanical engineering complex with an emphasis on economic recovery. First of all, they should include: a) ensuring the active and versatile activities of the state and the effective operation of the relevant government bodies at different levels; b) achieving the intensity of market self-regulation; i) formation of relations between engineering enterprises and the state; G) development of the system "state-science-education-business"; e) conducting the policy of large financial institutions and the banking sector.

A rational combination of modernization strategies from above and below will provide an integrated approach to solving the problems of economic security, which means it will allow the formation of an effective mechanism for the sustainable development of machine-building enterprises. In order to use the existing potential of the machine-building complex, it is necessary to develop an effective structural policy in machine-building and related high-tech industries that would meet modern conditions and could ensure a systematic and multifaceted transformation process, which involves further research and improvement of existing mechanisms for managing the potential of machine-building enterprises.

The results of the conducted studies allow us to assert that the difficulties in achieving the economic security of the state from the standpoint of mechanical engineering are due not only to the imbalance in the structure of the national economy and the unfavorable conditions for the expansion of economic activity and the modernization of the production base in all sectors, but also the underdevelopment and inefficiency of the mechanisms for implementing the structural policy of the state.

At the present stage, the following interrelated goals should be attributed to the main vectors for improving the machine-building complex:

- ensuring domestic production's high competitiveness in both domestic and foreign markets, and creating appropriate conditions for increasing the share of industries focused on product production to a high degree;

- alignment of structural deformations accumulated in the national economy, manifested in the restructuring of unprofitable sectors of the economy (with a preliminary analysis of the need for their restructuring from the standpoint of maintaining the state's economic security), which are not in demand, and debts on payments to natural monopolies and tax payments;

- completion of the process of transformation of the existing inefficient institutions of the transitional economy, including the structure of financial and commodity financial markets, state ownership and the system of state regulation, innovative mechanisms, etc., into institutions that meet the needs of the modern economy;



- assistance in the accelerated development of the economic system, markets and enterprises in the process of global economic transformation, which takes place on the basis of the creation of a new technological basis, the introduction of information technologies and the strengthening of regional and global integration processes.

It is necessary to develop a clear strategy of state policy, which would be based on the gradual transformation of the structure of the national economy based on the existing advantages of industries that are competitive in the international market, with the consistent growth of related industries and other economic complexes (Adamu, Dawha, Kamar, 2015).

State policy in this context should be guided by the priority development of those areas of the national economy whose products are in demand not only in the domestic but also in foreign markets. It is important that such an approach envisages both the development of the so-called "traditional" export-oriented industries (primarily the raw materials sector) and the modernization of "new" export industries (primarily processing industries) and service sectors.

Obviously, in order to ensure the economic security of the state, it is necessary to conduct a structural policy of the state that can eliminate the negative impact of structural imbalances that have formed in the national economy of Ukraine. However, the current principles of state policy are not closely related to the goals of ensuring economic security. Therefore, it is necessary to form general principles for the implementation of state policy for the purposes of ensuring national economic security at all levels :

- 1) the national level - the creation of a centralized mechanism for the implementation of structural policy; agreeing on goals to achieve sustainable economic growth and economic security;
- 2) the territorial level - the development and implementation of regional targeted programs that focus on ensuring the economic security of the state and are in strict coordination with state policy;
- 3) sectoral level - the formation of priority and competitive industries and directions for the implementation of state policy for the purpose of ensuring economic security based on the use of a combination of raw materials and innovative models of economic development;
- 4) micro level - the formation of conditions for the integrated development of business structures in priority sectors and areas of the economy.

The development of industry is the creation of conditions for the import substitution of innovative products and food products, the development of manufacturing industries, and the increase in the scientific and technical potential of domestic engineering in order to overcome the catastrophic redistribution between the industrial sector, the service sector, and the banking capital circulation sphere. A policy to smooth out structural disproportions at all levels of the national economy must necessarily include measures to overcome certain problems in the most significant branches of industry.

Obviously, in the context discussed above, the goal of state policy in the field of industry should be to increase the competitiveness of products manufactured in all sectors, to achieve a technical level of production that meets global standards, and to ensure the stability of the domestic real sector against domestic ones (in



this case, structural imbalances should be understood). between the real and banking sectors and the service sector and intra-industry disproportions) and external (economic and political instability at the international level) threats to economic security and creating conditions for the development of Ukraine's industry in the direction of import substitution and innovatively active industrial production to ensure its stable and sustainable economic growth.

It is necessary that the so-called dual-use technologies become the most widespread, which include: technologies for obtaining new materials; information technologies; microelectronics; technologies of highly efficient heat engines; biotechnology; high-performance industrial equipment; equipment for environmental protection; and unique technologies for experimental development and testing of complex systems .

Thus, in general, comprehensive measures for the development of industry will contribute to the modernization of individual technologies and production links (especially in the manufacturing industries), increase the level of the technological component at each enterprise and the introduction of advanced modern quality systems, certification of production and products. Ultimately, the implementation of these areas will lead to the sustainability of domestic industrial production and the achievement of positive shifts in the economy, which will be associated with an increase in the share of products manufactured by processing industries compared to extractive industries and an increase in the share of science-intensive and high-tech products in the structure of GDP; micro level - creating conditions for the systematic development of business structures in priority sectors and areas of the economy (financial, tax, consulting, property, scientific and technical) to overcome the gap in the level of development and technical equipment of enterprises in various industries and territories.

Due to the presence of a technological gap, business entities in various industries differ from each other in terms of the level of development of production technologies and the level of labor productivity. In addition, there is a serious problem associated with the discrepancy between the supply of technologies from the domestic research and development sector and the needs of companies in technological modernization. As a result, enterprises in our country are increasingly focusing on in-house research and development, only adapting imported technologies to the specific needs of the company, or exclusively on international developments (Table 1).

Table 1. Promising technologies and formats for business participation.

Main Categories / Technologies	Importance index	Business demand	Science proposal	Business Participation Format
<i>Mathematical modeling, methods of management and control of technological processes in</i>				
Computer technologies and simulation modeling for processing the results of monitoring and restoring a complete picture of the working conditions of the structure	60.4	2012-2017	2019	Private and public partnership



Intelligent systems for monitoring, diagnostics and automatic control of equipment and operating modes of power systems, "commercial dispatching"	10.5	2012-2017	2019	Funding already in progress
<i>New materials, technologies, manufacturing, etc.</i>				
Materials and coatings for extreme operating conditions	82.7	2012-2017	2020	Funding already in progress
High-performance polymeric, heat-insulating, heat- and fire-resistant materials, coatings and modifiers.	76.1	2012-2017	2018	Funding already in progress
<i>Energy saving</i>				
Solar energy converters with an energy conversion efficiency of at least 20 %	84.6	2012-2017	2018	Not ready
Thermoelectric current sources with a power of more than 500 W are autonomous or designed for complex heat recovery.	70.4	2012-2017	2018	There is not

Therefore, it is necessary to stimulate domestic enterprises in the real sector of the economy to innovate, which serves as an important instrument of state policy. To do this, it is necessary to ensure their gradual entry into new international markets. After all, international standardization is considered one of the effective methods of increasing competitiveness and the technical level of industrial production. Today, 42.6% of Ukrainian companies do not apply international technical standards in principle. However, if we consider various areas of activity, then here we can identify our leaders. Thus, companies in the mining industry use international standards in their activities more often than others: in 60% of companies, the share of products manufactured using international technical standards is more than 50% (State Statistics Service of Ukraine, 2021).

The development of innovative activity is an increase in the innovative component of the national economy in accordance with industries and regions in order to ensure a balance from an innovative point of view of the sectors of the national economy and business entities.

The priorities of the state innovation policy, the stages of its implementation and the key directions for the development of innovation activity are directly determined by the needs of industrial production from the standpoint of its technological re-equipment. On the one hand, the availability of investment resources and, on the other hand, the creation of appropriate conditions for the development of innovation activity must be carried out for the absolute modernization of the technological base of the domestic economy and a significant increase in the level of competitiveness of products of enterprises of the machine-building complex in Ukraine.

Consider the specific measures proposed above for the development of innovative activity, which are advisable to be carried out at all levels of the national economy:

1. National level – strengthening integration processes in science to improve the quality of training specialists in promising high-tech areas.



2. Territorial level – coordination of state, regional and local executive authorities to develop an integrated approach to solving the problems of innovative development, the functioning of the innovation system and the effective conduct of the innovation policy of the state.

3. Industry level – active financing of fundamental scientific research in scientific and technical areas in priority sectors, it is advisable to implement it in the form of a single state program with clearly defined development vectors.

4. Micro level – ensuring the protection and use of intellectual property; formation of a unified system of training and retraining of personnel in the field of innovative entrepreneurship; improvement of the financial situation of scientists; involvement of young people in science.

Increasing investment activity is the provision of the required level and structure of capital investments in the country's economy and its individual sectors.

It should be noted that the constant increase in the number of problems of the machine-building complex leads to a decrease in its economic potential and increases the probability of failure of such enterprises. Opportunities for development of machine-building enterprises focused on the introduction of innovations and modernization of production are not realized due to lack of state support, lack of own funds, high cost of loans, and low investment attractiveness.

CONCLUSIONS

Improving state policy as the basis for ensuring the economic security of the machine-building complex in modern conditions is to develop specific areas that should be implemented centrally. The model of ensuring the economic security of the state based on the improvement of the structure of mechanical engineering will allow: firstly, to significantly simplify the process of state influence; secondly, to combine state regulation of mechanical engineering along with the preservation of the operation of market mechanisms; thirdly, to ensure the economic security of the state by influencing all spheres of the economy through its proportions to achieve sustainability.

The mechanism for ensuring the economic security of the state contains the following interrelated elements: a) the main goal of implementing this mechanism, which is to form a toolkit for ensuring the economic security of the state based on the improvement of mechanical engineering and the elimination of threats to the economic security of enterprises; b) strategic tasks of the state policy of the country; c) the principles of ensuring the economic security of mechanical engineering on the basis of the state policy of the country; d) object of influence at all its levels.

Promising vectors for increasing the level of economic security of the country's machine-building complex should contain mechanisms for regulating and supporting the modernization of the machine-building complex with an emphasis on improving the domestic economy (the implementation of active and versatile activities of the state and the effective activities of the relevant government bodies at different levels; achieving a high intensity of market self-regulation; formation of relations between engineering enterprises and the state.



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Informed Consent Statement:

Informed consent was obtained from all the participants involved in the study.

Data Availability Statement:

The data presented in this study are available on request from the corresponding author.

Conflict of interests

The author declares no conflict of interest.

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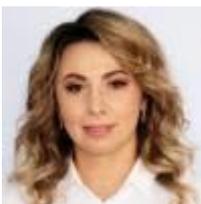


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