International Journal on Advanced Science Engineering Information Technology

Vol.12 (2022) No. 1
ISSN: 2088-5334

Development of Organizational and Economic Mechanism of Functioning High-Tech Enterprises in the Introduction of Digital Technologies

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***Abstract*—Scientists believe that an innovation-oriented enterprise is a specific type that is characterized by active innovation, creation, production, and sale of innovative products or products. In this study, the functioning of an innovation-oriented enterprise is based on the production of economic activity as the basis of its existence, and the use of innovation is the source and activator of its development. It is reasonable to consider innovation-oriented development as an ideology, a manifestation, and a way of development driven by or directed at innovations. The functioning of enterprises based on innovative productions ensures their self-development. The source of self-development is considered the enterprise's internal activity, and the tools are innovations, innovative changes, knowledge, and experience. For the implementation of self-development, the economic system makes the transition to a new level of functioning in the case of activation of the processes of change, the availability of the ability and interaction with the ecosystem of functioning, and the reproductive mechanism with maximum efficiency innovation. A feature of innovation-oriented enterprises in the production of self-development in functioning is the use of innovations in the development of potential, in updating and applying economic resources to form the ability to develop innovatively. In other words, it is reasonable to consider such an enterprise as a dynamic economic system that develops itself by operating in the process of functioning through innovative production in economic activity. The studied enterprises should have a high degree of functionality. At the same time, we consider a dynamic economic system to be a functional, innovation-oriented enterprise that can develop in the process of functioning and ensure the development of other economic systems along with meso-level institutions, transforming the results of their development for its further economic evolution.**

***Keywords*— Economic mechanism; high-tech enterprises; digital technologies; innovations.**

Manuscript received 3 Oct. 2019; revised 25 Jun. 2020; accepted 8 Feb. 2021. Date of publication 28 Feb. 2022.

I. INTRODUCTION

The digital economy is currently growing rapidly and will be the most important engine of innovation, competitiveness, and economic growth in the world in the next few years [1]. This is because it makes public and commercial services available, reduces the cost of promoting goods and products, reduces the time of payments, and opens up new sources of income [2], [3]. The digital economy is rapidly developing in a global world. Russia also does not remain aloof from this process. The digital economy share in developed countries' GDP is slightly more than 5%: in China, its volume is 6.9%, in the US and India -5.4% [4]. The volume of the economy of the Russian segment of the information and telecommunication network "Internet" in 2016 exceeded 1.5 trillion rubles (3% of GDP), the share of Internet-dependent sectors of the economy exceeded 19% [5].

The products of an innovation-oriented enterprise intended for sale can be innovative, contain innovative components that are equivalent to innovative, high-tech components, or can be created using high-tech equipment or using innovative technologies for both production and cost reduction. Innovative activities and R & D can be carried out by combining own and attracted capital using both created innovative resources and attracted in collaborative relationships with customers, suppliers, and other stakeholders.

Scientists mainly oriented to the classification of innovative companies, combining them with commutants competitive behavior [6], resource, technology, technical and food according to types of innovation, as well as forming several classification criteria: the novelty of products (brand new products, modernization of existing developments, technological improvements); the content of works (scientific-technical, scientific-production, intermediary technology development, and Advisory, scientific and technical services); by stages of the innovation process (development, prototype, industrial production, distribution, operation); by the market (global, domestic); by the degree of risk (very risky, moderate risk, low risk) [7].

However, it is advisable to add a division of innovation-oriented industrial enterprises according to the specifics of their functioning as the basis for their development before certain classifications [8]. This study proposes to divide enterprises by the first character into innovative maneuverable and innovative adaptive ones. Innovative adaptive enterprises show innovative activity, not systemically, as necessary, and innovative products do not differ in a high level of novelty, implementing mainly modification and local innovations, and, if there is an economic opportunity, – combinatorial. Innovatively agile can change innovation quickly and economic behavior, create and implement innovations systematically, constantly invest in innovative development and bring innovative products to the market [9].

According to the second feature, it is proposed to divide enterprises according to the orientation of innovative activity into producers of innovative products. The consumers (enterprises that attract innovative products or products for further use in their own needs), modifiers (enterprises that are engaged in complicated products to increase their cost and subsequent sale), producers are working based on a production franchise [10].

The specificity of innovation is subject to oriented production and enterprises with high-tech. Hence, we offer innovative and knowledgeable aspects.

It is advisable to divide innovation-oriented enterprises also by activity in using the type of innovation into developing/implementing ones are as follows:

- Managerial innovations, i.e., production remains unchanged, but approaches and methods to management, organization, and sales are improved or modified;
- Technical and technological innovations that ensure the development of the production subsystem of the enterprise;
- Product innovations – enterprises that create, modify, improve products;
- Mixed form.

II. Material and Method

The study's theoretical and methodological basis was the scientific work of Russian and foreign scientists related to the methods and organizational and economic mechanisms of high-tech enterprises in the implementation of digital technologies and their impact on the economic performance of enterprises.

This study uses scientific approaches and methods, such as a systematic and integrated approach, financial and economic analysis methods, logical and comparative analysis, expert assessments, and statistical and factor analysis.

The information base of this study are as follows:

- Legislative acts of the Russian Federation, including regulatory legal acts of the Government of the Russian Federation and the Ministry of industry and trade of Russia related to the functioning of industrial enterprises in the implementation of digital technologies;
- Results of scientific reports FSUE "research Institute "Center", materials of scientific conferences on the subject of the thesis [11];
- Russian and foreign publications on the development of the digital economy and Industry 4.0 programs.

III. Result and Discussion

Depending on the direction of using intellectual resources, innovation-oriented enterprises differ in the use of products for production, intermediate consumption (involves the creation of products and technologies not only for sale but also for improving production and organizational sales processes), commercialization and sale (enterprises that not only sell licenses, but also innovation proposals in the form of know-how), as well as a mixed form.

According to the share of ownership of intellectual property objects, innovation-oriented enterprises can be considered their sole owners and co-owners with investors and contractors in implementing innovative projects or fulfilling orders.

It is also advisable to distinguish such a classification feature as participation in the creation of innovations with a division into developers; custom enterprises, that is, those that prefer to create innovations through the subjects of innovation infrastructure (research institutes, design bureaus, etc.), without having their divisions; with collaborative economic relations that actively use client capital for innovation-oriented development [12].

According to the source of capital for innovation, enterprises can traditionally be divided into those that use their capital, investment resources, government allocations, or a set of them. Considering the legal field concerning certain norms established for certain types of innovation-oriented enterprises allows adding as classification features of rationing the volume of sales of innovative products and the volume of research and development costs. Economic value added shows the excess of net operating profit after taxes and the cost of using capital. EVA calculation formula is presented below:

$$EconomicValueAdded = NOPAT - WACC \times CE \quad (1)$$

$$EconomicValueAdded = (EBIT - Taxes) - WACC \times CE \quad (2)$$

$$EconomicValueAdded = (ROIC - WACC) \times CE \quad (3)$$

NOPAT (Net Operating Profit Adjusted Taxes) – profit derived from operating activities, after taxes, and before interest payments. WACC (Weight Average Cost of Capital) – the weighted average cost of capital. It represents the cost of equity and debt. In other words, this is the rate of return that the shareholder wants to receive on the money invested.

CE (eng. Capital Employed, Invested Capital, Capital Sum) – investment capital. At the beginning of the year, the sum of total assets is less interest-free current liabilities (accounts payable to suppliers, budget, advances received, other accounts payable). To calculate the weighted average cost of capital (WACC), use the following formula:

$$WACC = R_e \frac{E}{V} + R_d(1-t)\frac{D}{V}; \quad (4)$$

where Re, Rd – expected/required return on equity and borrowed respectively; E/ V, D / V – the share of equity and debt capital in the capital of the enterprise; t – the interest rate of income tax. Economic value added – the excess of the enterprise's profitability over the weighted average cost of capital. The higher the value of economic value-added, the higher the efficiency of capital use of the enterprise. Large values of EVA indicate a high rate of additional return on capital. EVA comparison of several companies allows choosing a more attractive investment.

To calculate the WACC, ROE (return on capital, profitability) can be compared to similar enterprises in the industry. In this example, the enterprise's capital management profitability, both owned and borrowed in the amount of 10% per annum, was taken. Based on the above formula, levers and factors of value-added economic management (NOPLAT, WACC, and CE) could be identified, the main of which is to increase the profitability/profitability of the enterprise by increasing sales. This can be achieved by reducing production costs through the use of new technologies. This model will not consider other factors, such as the cost of materials, raw materials, debt capital, and highly qualified personnel.

Any company is interested in increasing the added value because this figure will subsequently affect the final profit of the enterprise. In order to increase the added value, it is necessary to reduce the costs of the enterprise.

Based on the EVA indicator, the enterprise management model VBM (Value-Based management) is built, where all enterprise indicators affect changes in added value. Value-added of tangible (computers) and intangible (qualified personnel) assets for high-tech enterprises the author proposes to use the value-added coefficient VAC (Value Added Coefficient, determined by the formula:

$$VAC = CEE + HCE + SCE \quad (5)$$

CEE (capital employed efficiency) – the value-added of physical capital, determined by dividing the value added by the invested capital, shows how much-added value creates one physical capital unit. NSE (human capital efficiency) – the added value of human capital, determined by the division of added value by labor costs and labor ability to create added value. SCE (structural capital efficiency) – the value-added of structural capital, determined by dividing the difference between value-added and human capital (structural capital) by value-added. There is an inverse relationship between human and structural capital.

If we systematize the existing developments in the field of strategic planning of innovative development of the enterprise, we can identify the main approaches to the interpretation of its content [2], [4], [7] are as follows:

- The form of determining the economic opportunities and problems of an enterprise in achieving a set of long-term goals based on the implementation of the chosen strategy of behavior and development;
- A special type of scientific and practical activity, consisting in the development of strategic decisions that provide for the promotion of such goals and strategies of the behavior of the relevant management objects, the implementation of which ensures their effective functioning in the long term, rapid adaptation to changes in external conditions;
- The adaptive process through the system of formalized plans is regularly developed and adjusted. The content of activities for their implementation is reviewed based on continuous monitoring and evaluation of changes that occur outside and inside the enterprise;
- The process of forming a strategy, defining the enterprise's mission is based on the rational use of the strategic potential of the enterprise and maximum consideration of the dynamics of development in a changing environment.

Based on the above description, we can conclude that strategic planning of innovative development is characterized by an interconnected set of actions to strengthen subjects' viability and competitiveness. However, these approaches do not reveal the key features that identify strategic planning of innovative development with the enterprise's overall planning and do not distinguish between extensive and intensive ways of development of the business entity.

In this study, the strategic planning of innovative development of an enterprise is identifying areas of development. The prediction of likely results of implementation by the entrepreneur of provisions of the innovation strategy includes the optimal set of innovation input and output and the system that allows for the adaptive implementation, in a changing internal and external environment to achieve the main objective of functioning is providing opportunities for effective, sustainable development on the market.

It is also worth noting the main conditions for effective strategic planning of innovative development, in particular:

- A comprehensive set of innovations that are necessary to ensure the sustainable development of the enterprise;
- A variety of goals of the innovation process and a close relationship between the complex of tasks of innovation activity and the strategic goals of the enterprise;
- Multiple choice of innovations;
- The long-term nature of innovation results.

According to the above, the implementation of strategic planning of innovative development in the enterprise:

- Accelerates the continuous development of the organization and allows you to move to a new round of development; • provides competitive advantages based on leadership in the product and technology sector;
- Creates a basis for public recognition of the company.

Based on the principles of strategic planning [1], [3], this process in the context of innovative development of the enterprise should be considered as a sequence of interrelated processes, which implies:

- Analysis of forecasts of business results and assessment of the innovative potential to determine the strategic goals of innovative development of the enterprise;

- Comparison of goals and objectives with the likely change in performance indicators of key subsystems for their detailed analysis by business areas;
- Analysis of compliance of requirements to the conditions and potential of the enterprise for balanced development of the basic strategy of innovative development of enterprise;
- Introduction of a budgeting system for a balanced allocation of resources during the formation of the budget for innovative development of the enterprise;
- Step-by-step research of innovation effectiveness and assessment of the level of potential change in the process of implementing the company's innovative development strategy;
- Adjusting the provisions of the company's innovation development strategy by the update of goals and objectives to optimize the company's innovation development model;
- Introduction of innovation cycles to ensure the conditions for sustainable development of the enterprise.

Table 1 shows the calculation of the value-added coefficient for JSC "NPK " Uralvagonzavod". The net profit of the company is taken from the balance line 2400 and is the final result of the organization (NOPLAT). The sum of " capital and reserves "and" long-term liabilities " form the investment capital of the enterprise (CE). The higher the value added coefficient, the higher the efficiency of using digital technologies' intellectual capabilities in a high-tech enterprise. According to the research results, the value of the value-added coefficient is in the range from 2 to 15.

TABLE I
CALCULATION OF THE VALUE ADDED COEFFICIENT VAC FOR JSC NPK «URALVAGONZAVOD»

Indicator name	**Designation**	**2015**	**2016**	**2017**	**2018**
Weighted average cost of capital	WACC	7%	7%	7%	7%
Net profit(loss), thousand rubles	NOPLAT	5 688 000	5 714 000	5 441 000	8 102 000
Capital and reserves, thousand rubles	I	54 955000	45 607 000	40 511 000	39 434 000
Long-term liabilities, thousand rubles	TO	115 701 00	103 717 000	84 221 000	91 551 000
Economic Value Added (EVA)	**NOPLAT-WACC(I+TO)**	**-6 257 920**	**- 4 738 680**	**-3 290 240**	**- 1 066 950**
CEE (capital employed efficiency)	CEE=EVA/I	-0,11	-0,10	-0,08	-0,03
Human capital (labor costs), thousand rubles.	Hc	5 291 960	5 317 514	4 043 068	2 144 045,00
The NSE (human capital efficiency)	HCE=EVA/Hc	-1,18	-0,89	-0,81	-0,50
SCE (structural capital efficiency)	SCE=(EVAHc)/EVA	1,85	2,12	2,23	3,01
Value added ratio VAC	**VAC = CEE + HCE + SCE**	**0,55**	**1,13**	**1,33**	**2,48**

The new technological approach's key advantages are full transparency of the product life cycle and the ability to actively manage changes from the design stage to the delivery of finished products to the customer and its service. However, the value chain elements are continuously optimized according to various criteria, such as cost, resources, and seriality. Using digital models of the product and the production process ("digital twins") allows you to make the necessary number of virtual adjustments to achieve the desired result.

The introduction of a single digital space is associated with integrating production equipment into a single network. It determines the transformation of processes and models of relationships between participants in the industrial products' value chain. The key tools for this transformation are electronic trading platforms, particularly "exchanges" of manufacturers and suppliers of logistics services.

The most significant technologies are used and have the greatest depth of penetration into technological production. At the same time, the depth of penetration of digital technologies into production is not significant. It is only 7% to 21%. However, these are good initial conditions for introducing digital technologies in the vast production even though the Federal target program "Development of the defense industry until 2020" has no direct reference to its development in the industry. It focuses on increasing orders, strengthening inter-plant cooperation, and re-equipment of production; without information technology, its effective implementation is not possible.

The amount of data that needs to be accumulated across the industry is enormous. A single database capable of multi-dimensional analysis of information on all enterprises will ensure the most successful FTP implementation in a given time.

TABLE II
SIGNIFICANCE, DEPTH OF PENETRATION, EXPECTED RESULT AND TERMS OF INTRODUCTION OF DIGITAL TECHNOLOGIES IN PRODUCTION, IN %

No	Class of problems	Importance	Penetration depth	Expected result*	Expected completion date
I. Carrying out engineering calculations using mathematical modeling software of domestic development					
1.	Aerodinamica	33%	11%	to 95 %	2020
2.	Hydrodynamics	33%	11%	to 95 %	2020
3.	Strength	33%	11%	to 75 %	2020
4.	Heat and mass transfer	33%	11%	to 90 %	2020
II. The creation of a domestic base of integrated information management platform, organizations of industry and of its components, which will be accompanied by design and manufacture of armament and military equipment of dual and civil areas, management of their lifecycle in organizations					
5.	Digital design	43%	18%	to 85 %	2022
6.	Business process management	43%	18%	to 100 %	2022
7.	Enterprise/production management	43%	18%	to 85 %	2022
8.	Application of domestic operating systems and database management systems	22%	7%	to 95 %	2027

III. Providing stage of the transfer of these companies to work with specialized software developed in Russia					
9.	Availability of industry solutions	35%	16%	to 100 %	2027
10	Cooperation chain management	43%	18%	to 85 %	2023
11	Transition to digital product layouts	43%	18%	to 95 %	2027
12	The use of cross-sectoral system of normative information	35%	16%	to 100 %	2025

Rostec Corporation plans to launch the first "factory of the future". "Factory of the future" means a new industrial site format that combines technology and business solutions. The first such site will appear based on the Saturn UEC and will be a test site for testing technologies applicable, particularly in manufacturing complex aircraft parts. By 2035, Russia created about 40 "factories of the future", 25 test sites, and 15 experimental digital certification centers.

To create a full-fledged network of "factories of the future," it is necessary to form a technological and regulatory framework. Currently, a separate program for the development of inter-industry standards in such areas as cyber-physical systems, mathematical modeling, industrial "Internet of things," "smart production," and "smart cities" in the framework of digitalization of industry is being implemented.

Thus, in its industry of the defense industry of Russia as a whole, there have been positive trends. Of course, these processes are not going as fast as we would like because of the country's difficult economic situation, which has developed against the background of unjustified international sanctions.

The number of successful implementations of complex automation of defense industry enterprises using domestic circulation ERP systems has increased. There are specific examples of refusal of machine-building enterprises from the choice of management systems of foreign origin and migration from foreign ERP systems to domestic ones. There has been a consistent qualitative growth of competencies in the field of Informatization.

Currently, the automated system of the unified information space of the defense industry, the state information system of industry (GIS), the automated state system for assessing financial and technological risks arising from the implementation of the state defense order have been created and are functioning.

Thus, it is possible to formulate proposals for the further development of information support of defense enterprises are as follows:

- It is necessary to approve the concept of creation, development and use it in the defense industry for the period up to 2025 and the updated "road map."
- It is required to initiate the creation of a complex target program for the implementation of the best global standards in development practice. Production and operation of armament and military equipment samples are subject to ensure the quality of military products based on the development strategy and harmonization. Implementation of the Russian Federation territory is based on the existing international policies and standards in the field of information technology. The information security and development and promotion (replication) at the international level (including the EEU, CIS, BRICS, SCO, APEC) were based on progressive policies and standards for 2014-2020. They are all together with the action plans ("road map") and financing of the Russian Federation, after its approval by the Government of the Russian Federation.
- It is advisable to consider the possibility of targeted state support for domestic system development and engineering SOFTWARE.
- It is necessary at the state level to consider the possibility of securing and preserving copyright for developers of domestic SOFTWARE in the performance of state orders.
- It should prolong the project "Development of supercomputers and grid technologies" for 2017– 2020 on the principles of equity in its funding of state and head of machine-building enterprises of Russia and creation on this basis of the consortium on development of supercomputer technologies in the automotive industry with the participation of the leading technical universities in the country.
- It is compulsory to approve a "road map" of development Strategy, harmonization, and implementation on the territory of the Russian Federation of existing international policies and standards in the field of information technology and information security as well as development and promotion (replication) at the international level (including the EEU, CIS, BRICS, SCO, APEC, etc.) develop policies and standards for 2014-2020, together with plans of action ("more expensive card") and financing of works of the Russian Federation.

IV. Conclusion

The study of methodological apparatus of development of an organizational and economic mechanism of functioning of high-tech enterprises in introducing digital technologies on the example of enterprises of the Russian defense industry allowed to formulate some conclusions and obtain scientifically and applied results. Among the most important are the following.

The author's interpretation of the concept of the organizational and economic mechanism of industrial enterprise management in introducing digital technologies is given. They increase labor productivity, quality of technological processes and, of course, increase the economic efficiency of the enterprise's activity. The concept penetration depth of digital technologies in the defense industry's high-tech enterprises is a percentage of the actual level of use of digital technologies in the defense industry of the required level.

The influence of digital technologies on the prospects of development of defense enterprises is shown. The introduction of the automated information system of project management of the Ministry of industry and trade helped create a monitoring tool and improve the efficiency of the

project, running for the Federal budget to change the culture of project management throughout the Ministry.

The introduction of a single information space allowed for uninterrupted interaction between the process participants gave the Russian Ministry of industry and trade an effective tool for monitoring the state of the country's industry and allowed it to respond quickly and specifically to changes in market conditions, offering targeted measures to stimulate those industries that most need support.

However, the study revealed no standardized, unified methodology for introducing digital technologies in the defense industry and typical patterns of its program implementation. The processes of equipment selection, development, and implementation of infrastructure solutions at defense enterprises remain opaque, non-systemic. Currently, they do not lend themselves to unification and standardization, which is the main deterrent to introducing digital technologies at defense enterprises.

The paper proposes a model of information support for the production of high-tech products defense industry. In contrast to the known ones, this model reflected the composition and interrelation of the enterprise's business processes, the stages of the life cycle of high-tech, science-intensive products, and digital information technologies. It allowed identifying the main areas of work on the self-assessment of the enterprise's existing level of digitalization, based on which measures were developed to introduce digital production technologies. Given the author's significant impact of digital technology on the enterprise's value added, the proposed method increases the accuracy of economic efficiency estimation of digital technology's introduction.

ACKNOWLEDGMENT

We are grateful to the Russian International Science Institute for permits to use and revise RISI's template.

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