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Managing the Development of the Rocket-Space Enterprise Innovation Potential

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***Abstract*—The effectiveness of the innovation activity of a knowledge-intensive enterprise in the rocket and space industry is determined by the value of the available innovation potential. It characterizes by its very nature the organization's ability to solve problems related to the production of new competitive products, the implementation of innovative projects and technology transfer independently. The aim of the research is to formalize the process of managing the development of the innovative potential of knowledge-intensive enterprises in the rocket and space industry. The tasks that were set and solved during the implementation of the research can be described as follows: 1) to propose a conceptual approach to managing the development of the innovative potential of a knowledge-intensive enterprise in the rocket and space industry; 2) to form an algorithm for managing the development of innovation potential. It is proposed in the work that the process of solving problems related to managing the development of the innovation potential of a knowledge-intensive enterprise in the rocket and space industry be divided into six successive stages, the results of which will be taken into account in the program of innovative development of the enterprise.**

Keywords—rocket-space enterprise; innovation potential; innovation activity; knowledge-intensive enterprise; innovative development

I. INTRODUCTION

At the current state of the Russian Federation, the practical implementation of a socio-economic development strategy aimed at the formation of an innovative economy has become a task of paramount importance. To achieve serious economic growth, we need mechanisms to create new, innovative types of products, works and services, based on the scientific and technological and production potential that has not yet been lost on the basis of individual high-tech manufacturing enterprises. [1]

In Russia, the unified scientific and technological complex functioning in the Soviet period, including fundamental, applied industrial science and production, was significantly deformed during the years of reforms [2]. Industrial science, as a link between fundamental, exploratory research and production, was virtually destroyed. As a result, enterprises had to take over some of the functions of organizing applied research to create promising products and technologies. As a result of these changes, a new type of organization is emerging in Russia - a knowledge-intensive enterprise, which is considered by domestic scientists to be the most important factor in raising the national economy.

II. RELEVANCE

The concept of knowledge-intensive industries and enterprises, in economics appeared about three decades ago. However, despite the fact that during this period a lot of scientific works devoted to this topic were published, the basic terminology has not yet been settled. Assigning the industry or production to be considered knowledge-intensive or high-tech is rather arbitrary.

In their study, the authors represent the refined concept of a «knowledge-intensive enterprise», which is proposed to mean an organization whose purpose is development and production of high-tech products, and the distinctive features are: a high proportion of research and development costs, a high level of staff qualifications and technologies.

Under the quantitative criteria by which the company can be attributed to the knowledge-intensive, refers to the following:

- High proportion of domestic expenditures on research and development in the amount of expenditures on production and sales of products (more than 3.5%).
- High proportion of knowledge-intensive and high-tech products in the total output of the company (more than 50%).
- High technological level of production, largely based on the technologies of the fifth technological paradigm.

The qualitative characteristics of knowledge-intensive enterprises of the RSI are the following:

- A knowledge-intensive enterprise is performing the most important function of a system integrator of research and development, the results of which are realized in the created high-tech products.
- Pilot production is present in the structure of the enterprise.
- Developed network interaction with suppliers of components, as well as scientific, design and educational organizations, in relations with which a knowledge-intensive enterprise acts as a customer of products or services.
- High educational level of employees.
- Significant portion of the total number of employees engaged in research and development and technological development of the enterprise.

The rocket and space industry (RSI) is one of the basic branches of the military-industrial complex (MC) and is characterized by a high share of knowledge-intensive and high-tech industries, products and services [3]. The industry historically possesses a unique innovative rocket and space potential that allows solving strategic tasks on improving and developing rocket and space technology (RST) for the national security, socio-economic development of the country, development of science and international cooperation, ensuring guaranteed access and the necessary presence of the Russian Federation in outer space. [4, 5]

Russia is widely represented in the following areas of the rocket and space industry [6, 7]:

- Cosmonaut training.
- Launch servises.
- Building space stations.
- Services/works performed in space.
- Satellite industry.

Satellite industry has four main segments [7]:

- Satellite services.
- Constructing ground equipment.
- Satellite production.
- Launch services.

Satellite services. The market of satellite services consists of the following parts: navigation, geodesy, meteorology, connection and so on. The volume of the world market of satellite services in 2002 was $50 billion, which is more than 57% of the satellite industry world market. Regarding the possibility of selling Russian satellites and related equipment abroad, this segment is the most appealing and dynamic.

Constructing ground equipment consists of the following:

- Mobile terminals.
- Control.
- Surveillance stations.
- Digital Satellite Broadcasting antennas.
- Portative phones.

Nowadays for Russian manufacturers, construction of GLONASS navigation systems mobile receivers is relevant.

Satellite production. This market can also be divided depending on the type of constructed satellites:

- Connection.
- Navigation.
- Earth remote sensing.
- Meteorology and geodesy.

Connection. It is enough to give only one example: without the domestic group of connection and retranslation spacecrafts, there could be no television broadcasting in Siberia and Far East. Exactly this market niche is changing today. Apart from JSC, which is traditionally occupying the niche, there are several companies competing for orders, such as RSC Energia (YAMAL satellite constellation) and Khrunichev SRPSC (KAZSAT satellite).

Space navigation. Today every plane or train for international travels has to be equipped with a satellite navigation signals receiver. There are only two global satellite navigation systems: American NavstarGPS and Russian GLONASS. This is a huge market of space services. That is

why on the highest government level, special attention is paid to problems of domestic space navigation development; the related special federal program is developed and implemented. And the main economic effect from the program is expected not from military, but from civilian segment. In 2010, the deployment of GLONASS across the territory of Russia, and later the whole world, should have been completed. However, in December 2010, because of the accident with launch vehicle "Proton" equipped with three Glonass spacecrafts, date of the full deployment was pushed back. New spacecrafts were being made in JSC, which were planned to launch in 2011.

Earth remote sensing (ERS). Even with significant expenses on creating space systems of cartography and mineral exploration, it is an attractive property. This market dynamically develops; more countries are willing to have their own ERS systems. It should be understood that the difference between ERS and space exploration is symptomatic. This is why information from ERS systems is being used in the interest of defense and military, and vice versa.

The development of RSI is one of the main priorities of the state policy of Russia, which determines the national status and influence of our country in the world as a country highly developed in science and technology. In 2011, the share of the rocket and space industry in Russia in the global production of rocket and space technology was 10.7%.

It should be noted that space activity in the world is developing at a rapid pace, and today more than 120 countries are involved in space activities, and space agencies have already been created in 60 countries and there are various space programs. At the same time, the development of the international market is very dynamic: over the past five years, it has grown from 170 billion dollars to 250 billion, and such trends can be traced further. At the same time, the sector of the production of rocket and space technology today is 72 billion dollars, and Russia's share here is just over 10%. The Russian Federation controls more than 30% of the means of providing launch services in the world, and for the production of spacecraft our share today is 7%. The rest of the market (over 115 billion rubles) is income from service operators: television, Internet, telecommunications; just over 50 billion are ground-based equipment for receiving space information, according to various estimates, Russia's share in this market is from 1% to 1.7%.

According to the approved state program for the development of the space industry, the main problem of the RSI is the incompatibility of the space industry's capabilities with the new requirements of the state and the global space market.

III. Formulation of the problem

In today's rapidly changing external conditions, innovative development is seen as the only way to increase the competitiveness of products, maintain high rates and ensure the sustainable development of knowledge-intensive enterprises.

The need for continuous innovation development of knowledge-intensive enterprises constantly makes new demands on the content, organization, forms and tools of innovation, one of which is the innovation potential. As a result, enterprises have tasks that are associated with the need to explore the process of managing the innovative potential, to increase its efficiency, both in dynamics and spent resources.

IV. Results and Discussion

In this study, the authors adhere to the following notion of «innovation potential of a knowledge-intensive enterprise RSI», which is the ability of an enterprise to create promising samples of rocket and space technology, expressed in:

- special competences in the field of research, design and technological work [8];
- reserve of scientific and technical developments, developed material and a technical base for development, testing and production of RST [9];
- qualified personnel;
- modern innovation management system [10].

A distinctive feature of this definition is the fact that the presence of special competencies is the primary characteristic of the innovative potential of a knowledge-intensive enterprise of the RSI. [11]

The development of the innovative potential of a knowledge-intensive enterprise of the RSI should be aimed at solving strategic tasks to create promising RST samples and to produce high-tech civilian products, to ensure the competitiveness of the enterprise and its adaptation to uncertain, changing environmental conditions. [12, 13]

This study proposed a conceptual approach to managing the development of the innovation potential of a knowledge-intensive enterprise RSI, the essence of which is: to identify the need to build up the innovation potential for each element (competence level, research and development, technological level, personnel, management system); to elaborate a development program with specific activities, limited in time and scope of work; improving the organizational structure of production and management for new tasks; monitoring the implementation of the program.

At its core, the conceptual approach is designed to develop a single, defining design for the formation and development of innovative potential, which implies the establishment of requirements that are implemented through the observance of relevant principles.

The analysis of the main provisions of modern innovation management [14, 15], components of the innovation potential presented in [10], as well as the relations between them, allowed us to identify the private principles of how to form the development management system of the innovation potential:

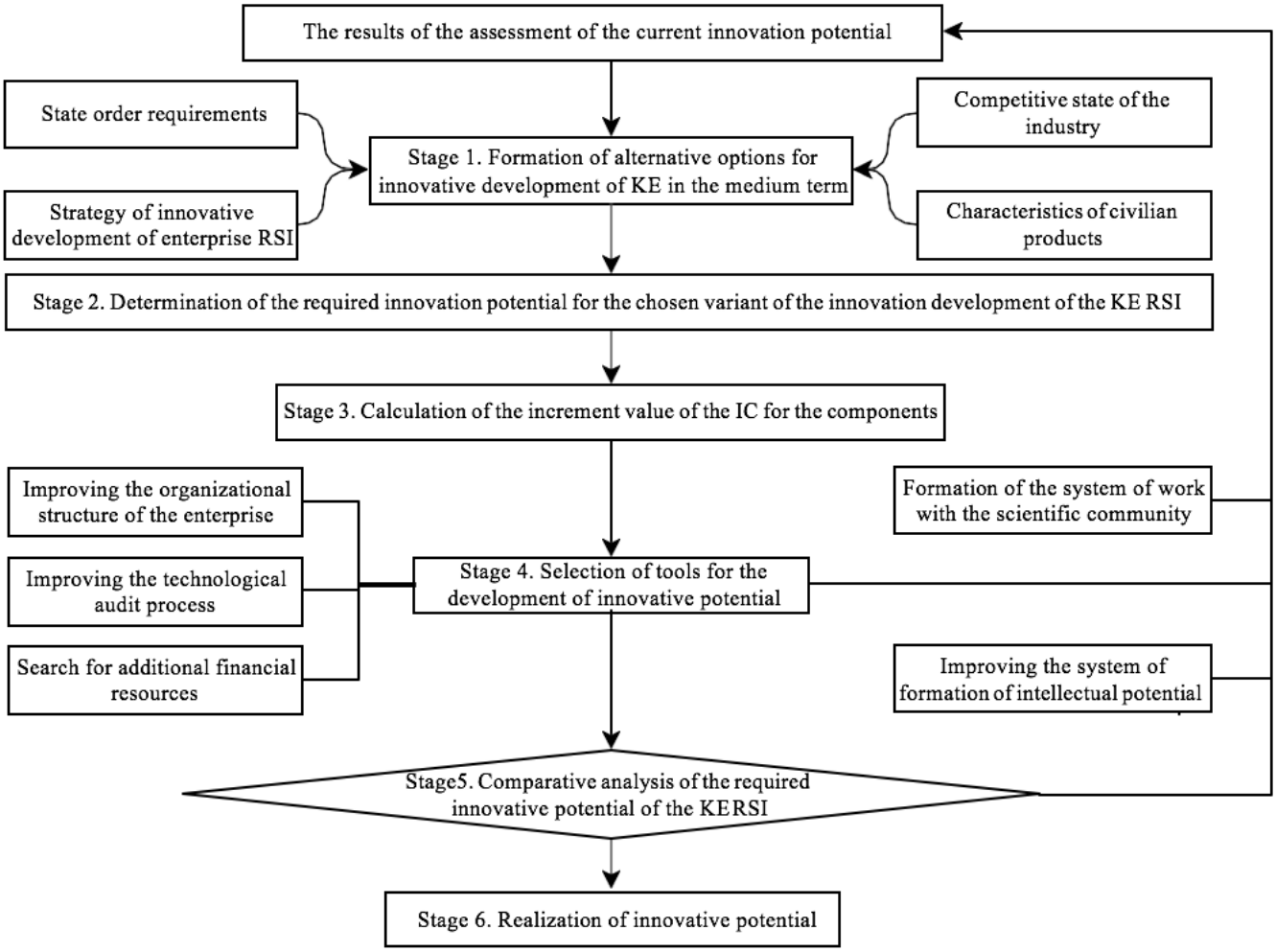

Fig. 1. Stages of managing the development of the innovative potential of an RSI knowledge-intensive enterprise

- Principle of diffusion, which enables the flow of ideas and developments from military to civilian production in the process of developing innovative potential.
- Principle of reproducibility of innovative potential based on commercialization is to take into account the nature of the relationship between the costs of its development and the magnitude of the increase in the subsequent period.
- Payback principle of the innovation potential characterizes the sufficiency of profits derived from the sale of civilian products and the fulfillment of government orders to cover the costs associated with building up the innovation potential for the future needs of the state and the market.
- Principle of advance makes available advanced research and development necessary for the future needs of the state and the market, based on global development trends.
- Principle of sustainability characterizes the process of systematic and continuous identification, evaluation, formation and use of the innovative potential of a knowledge-intensive enterprise, taking into account the specifics of the activities of the PSI and ensuring its effective development.

Based on the selected principles, the following can be attributed to the key tasks of managing the development of innovative potential: 1) planning the necessary innovation potential, taking into account the impact of factors affecting the innovative development of knowledge-intensive enterprises, presented in work [16]; 2) ensuring the growth of components of the innovation potential due to available external and internal resources; 3) realization of the innovation potential in the form of the final product - knowledge-intensive products, new technology, obtaining new knowledge to form a scientific and technical reserve.

Based on the methodology of using the goal tree method [17], the process of solving the tasks of managing the development of the innovation potential of the PSI is proposed to be divided into six successive stages, the results of which will be taken into account in the program of innovative

development of the enterprise. The stages of managing the development of innovative potential are presented in fig. 1.

The features of the development process and implementation of the proposed conceptual approach to managing the development of innovative potential at the enterprise of the PSI should include the following:

1. The system for managing the development of innovative potential should be based on the fundamental principles of a systems approach and include a mechanism for creating individual transformations in all areas of a knowledge-intensive enterprise.

2. For the effective development of the innovation potential of a knowledge-intensive enterprise of the RSI, it is necessary to create an organizational structure consisting of specialists who have the appropriate training and are responsible for the effectiveness of the implementation of the developed measures.

3. Evaluation of the effectiveness of the innovative potential reproduction should be carried out according to the results of the implementation of the knowledge-intensive enterprise of the RSI's main activities: military and civilian output.

4. When implementing the program of innovative potential development in a knowledge-intensive enterprise, it becomes fundamentally important to create a system of continuous monitoring of the enterprise's innovative potential.

5. The formation of key competences, on which the development of innovative potential is based, must be systematized in the form of internal standards for a knowledge-intensive enterprise when making management decisions.

V. CONCLUSION

Summing up the study, it is worth noting that one of the promising ways to ensure the competitive development of knowledge-intensive enterprises is to organize an effective system to increase the innovation potential.

The authors hope that the application of the proposed conceptual approach to the development of the innovative potential of a knowledge-intensive enterprise of the RSI will improve the effectiveness of innovative development programs and obtain the economic effect from the introduction of the proposed tools, which will, in turn, strengthen the organization's position in a competitive market.

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