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INSTITUTIONAL ANALYSIS OF RESOURCE POTENTIAL FOR KNOWLEDGE GENERATION IN THE ENTERPRISES OF THE REGIONAL MILITARY-INDUSTRIAL SECTOR [1]

This article discusses the processes of knowledge generation in the enterprises of the military-industrial sector that are the leaders of innovation in the region. The purpose of the study is to develop a methodology based on using the resource potential to improve the efficiency of knowledge generation in the instrument-making enterprises of the military-industrial sector. The authors conducted a system analysis of knowledge generation in one of the enterprises of the military-industrial sector that led to the conclusion on the chaotic character of knowledge generation in such enterprises and its insufficient provision with institutions. The authors proposed a method for designing a knowledge generation system in the enterprises of the regional military-industrial sector by taking into account the means and capabilities of the enterprise in the implementation of intellectual activities. The developed method is based on defining the horizontal resource potential of knowledge generation and allows to determine the potential use of resources at each stage of the product lifecycle. The comparison of actual and theoretical values of horizontal resource potential will allow to adjust the allocation of share held by each of the resources within the stage, and thereby optimize the implementation of tasks at a particular stage. The proposed tools were tested in 2015 in one of the enterprises of the regional military-industrial sector. The methodological tools used in this study include such methods as the expert assessment, mathematical statistics and institutional analysis. The proposed methodology and empirical results have been used as a basis to develop the institutional spiral of knowledge generation during the performance of state order in the enterprises of the military-industrial sector, the implementation of which will help to reduce the level of uncertainty throughout the entire lifecycle of innovative product. The developed institutional spiral of knowledge generation in the instrument-making enterprises of the military-industrial sector involves the provision of incentives for knowledge generation at each stage of the product lifecycle. The results of this study can be used to build the diagram of knowledge generation and apply the procedures for increasing the efficiency of knowledge generation in the enterprises of the military-industrial sector.

Keywords: institutional economics, knowledge generation, innovation, methodological tools, military-industrial sector, state-owned enterprises, resource potential, institutional spiral, product lifecycle, state order

Problem Formulation

According to statistical data, 58.6 % of R&D activities in the Russian Federation are funded through the state budget, i.e., most of the research is conducted as part of performing the state order[2]. This fact provides the rationale for studying the characteristics of knowledge generation in the state-owned industrial enterprises.

The state-owned enterprises of the military-industrial sector have the following characteristics:

1. The state represented by the Ministry of Defense of the Russian Federation acts as the customer for all enterprises of the military-industrial sector. It determines what product will be manufactured, its characteristics, and production time frame.

2. Operations in the high-tech sector and, as a result, knowledge-intensive manufacturing processes [1].

3. Closed nature of operations given the secrecy of performed works.

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[1] Original Russian Text © Popov E. V., Vlasov M. V., Shishkina A. Yu., Yakimova A. V., published in Ekonomika regiona [Economy of Region]. — 2016. — Vol. 12, Issue 3. — 839–851.

[2] Generatsiya znaniy pri innovatsionnom razvitii kompnii [Knowledge generation in the innovative development of the company]. Retrieved from: www.center-yf.ru/data/Menedzheru/Generaciya-znanii-pri-innovacionnom-razvitii-kompanii.php (date of access: December 19, 2015).

4. Long-term duration of orders. Virtually all enterprises of the military-industrial sector have orders for several years ahead. Previously, the orders were given for one year, but the bureaucratization of the system contributed to the delays in approval of the plans and, as a result, led to failures in meeting the deadlines of their implementation.

5. A full cycle of innovation process [2].

6. Large capital investments. Recently, the enterprises of the military-industrial sector began to receive new equipment, devices, and software. This was made possible by the allocation of funds in the form of advances for manufactured products [3].

7. Specifics of pricing for defense-purpose products. The prices are defined by specially approved documents.

8. The presence of military representatives, who monitor the manufacturing of military products at all stages of manufacturing.

9. Most enterprises of the military-industrial sector manufacture products not only for military but also for civilian purposes. [4]

The high level of innovative activities in the military-industrial sector is determined by the capability to develop and manufacture the products required by the state (military-purpose products) and the market (civil-purpose products), capability to modernize its organizational and technological structure that ensures the performance of state order, as well as the ability to effectively renew such basic factors of production, as labor, capital, and knowledge [5].

The above characteristics demonstrate the need to consider the knowledge generation in the enterprises of the military-industrial sector as a case of innovative production in the knowledge economy.

A considerable amount of studies have been made by Russian and foreign scholars to address the issues of the knowledge economy. This included the analysis and systematization of main tools used for modeling the knowledge economy [6], assessment of socio-economic aspects related to the emergence of knowledge society in Russia [7], revealing the importance of developing a socially-oriented market economy [8], development of models for managing the technological development of innovation economy [9].

In the Russian scientific literature, the starting point for the development of knowledge economy was a report of V.L. Makarov on Knowledge Economy: Threats to Russia made at the general meeting of the Russian Academy of Sciences in 2003. However, unlike F. Machlup, he understood the knowledge economy as "a type of economy in which knowledge plays a decisive role and the production of knowledge is the source of economic growth."

The merit of G.B. Kleiner is the elaboration of socio-economic aspects of the knowledge economy. Together with V.L. Makarov, he examined how the data is transformed into knowledge, provided the rationale that the emergence of knowledge as a social phenomenon requires a well-developed institutional environment, and made a conclusion that knowledge and institutions are inseparable from each other. [10]

Three main areas of research related to the innovative behavior of firms can be distinguished in the world's scientific economic literature. The first area is developing within the neoclassical economic paradigm and addresses mainly research tasks that have been set already by J. Schumpeter, namely, what market structures maximize innovation, and whether competition facilitates technological advances [11]. Among the works in this area, we can mention the already classical studies on the search of the relationship between the market structure and the amount of R&D (G. Loury [12], T. Lee and L. Wilde [13], R. Sah, J. Stiglitz [14], V. Delbono, V. Denikolo [15], J. García-Manjón and M. Romero-Merino [16], and others); substantiating the factors that facilitate (prevent) the network interactions between the firms in R&D (P. Dasgupta and E. Maskin [17], E. Harrison and H. Koski [18], L. Dahlander and D. Gann [19], M. Ferrari [20], and others); identifying incentives for knowledge generation both in already operating (including the monopolists) and newly established firms (K. Arrow [21], J. Reinganum [22], D. Teece [23] G. Festel [24], and others).

The research subject of scientists working in the second area based on the principles of the evolutionary paradigm is the innovation lifecycle and individual stages of innovation process. A pioneering work that brought attention to the issue of cumulative research in the innovation process was the scientific article written by S. Scotchmer [25]. Later on, this area was developed by such scholars as V. Denicolo [26], T. O'Donoghue [27], R. Hunt [28] and others.

The third area of research on the innovative behavior of firms is represented by various classifications of knowledge generation strategies. The scientific literature provides several typologies of knowledge management strategies. In most cases, the following attributes are used for the classification of knowledge management strategies:

The use of own or borrowed knowledge (R. Grant) [29]; extent of changes introduced to the knowledge of organization (radical or incremental) (J. March) [30]; speed of introduction and dissemination of new knowledge in the organization (P. Bierly, A. Chakrabarti) [31]; breadth of knowledge base (G. Hamel, C. Prahaland) [32].

As we can see, the institutional economic theory is successfully applied to analyze the trends in the development of knowledge economy. [2]

At the same time, analysis of developments in the modern economic theory demonstrates that there is an insufficient number of institutional studies on the provision of resources to support the knowledge generation [33].

The purpose of this study is to elaborate a methodology based on the use of resource potential to improve the efficiency of knowledge generation in the enterprises of the military-industrial sector as an engine of innovation in the region.

After analyzing the findings of Russian and foreign scholars who studied the patterns in the present-day conditions of enterprises in the military-industrial sector and based on their own previous research, the authors have made an assumption that the assessment of resource potential used in knowledge generation will allow to optimize the allocation of resources in the enterprises of the military-industrial sector, which will increase the efficiency of knowledge generation by the enterprises of the military-industrial sector.

Methodology of the Research

As the methodological base of the research, we used the method of analyzing the financial results for assessing the sustainable development of economics in the enterprises of the military-industrial sector [34], methodological tools for ranking the financial and economic condition of enterprises of the military-industrial sector [35], methods for assessing the effectiveness of implementing the innovative projects in the enterprises of the military-industrial sector [36], methods for assessing and analyzing the competitiveness and sustainable development of defense industry enterprises [37].

The study has been conducted in two areas. The first area includes the study of functional elements in the integrated methodology for calculating the resource potential of the enterprise. In the opinion of the authors, the potential of using the knowledge generation resources represents a set of means and capabilities of enterprises in the implementation of intellectual activity. The second area of study is related to obtaining the specific results, that define the set of means and capabilities of the enterprise in the implementation of intellectual activity, and will be based on the results obtained in the first study.

To determine the ways for optimizing the existing knowledge generation system, the method of analysis and synthesis has been used in the study[3]. This method allows to study the socio-economic phenomena and processes by their components (analysis) and as the whole (synthesis). The choice of this method is determined by the integrated approach to complex (multi-level) research subjects. Such subjects (systems) are increasingly viewed as a system of interrelated components (subsystems).

After using the method of analysis and synthesis to study the integrated model of knowledge generation, we conducted the analysis of horizontal allocation of resources within each stage of the product life cycle, vertical allocation of each type of resources in all stages, and then we summarized the results into a single model in order to develop a plan of recommendations on optimizing the existing system.

Also, during the study, we used the method of expert assessment to obtain the quantitative estimates of qualitative characteristics and properties[4]. In this case, this method was used to determine the values of weighted coefficients as ideal indicators.

[3] Metody ekonomicheskikh issledovaniy [Methods of economic research] Retrieved from: http://center-yf.ru/data/Marketologu/Metody-ekonomicheskih-issledovanii.php (date of access: December 19, 2015).

[4] Ekspertnoye otsenivanie [Expert assessment]. Retrieved from: https://ru.wikipedia.org/wiki/Экспертное_оценивание (date of access: December 8, 2015).

The expert assessment was conducted by a survey among the top and middle management, which involved the individual work of each expert. Such range of respondents was selected in order to obtain the most reliable results, since it is the executives who have the necessary knowledge and information to address the established task. The results were processed with the method of mathematical statistics by averaging the obtained data.

The subjects of the study include the processes of knowledge generation in one of the enterprises of the regional military-industrial sector. This enterprise is a research and production company, the main purpose of which is to perform the state order.

The main stages of the study were as follows:

1. Identifying the system of indicators for each type of resources, defining the calculation procedure. This stage requires to substantiate theoretically the choice of indicator system for financial, material, human, and information resource group. Moreover, each system should consider the particular characteristics of enterprises included in the military-industrial sector. The selected indicators should be measured in the same units and apply to all units of the enterprise that are responsible for performing a particular stage of the product lifecycle.

2. Obtaining from the heads of the relevant units the actual quantitative values of previously defined indicators. This stage requires to submit requests to the units responsible for performing a particular stage of the product lifecycle for the provision of data on the relevant indicators. The results are structured, normalized by the total quantity and recorded in the columns of actual values in the summary tables.

3, 4. Selecting the experts, conducting the testing. The experts are selected among the middle and top management at the enterprises of the military-industrial sector based on the principle of having the largest amount of information on the activities of particular enterprise. One of the important conditions for selection is the independence of expert opinions, i.e. the surveyed executives should not be directly involved in any stage of the product lifecycle and should have the information on the overall lifecycle. The number of experts should be no less than five; otherwise, the assessment will not be accurate.

Experts are asked to complete a questionnaire that includes several tables and are given the instructions on its completion.

The method of expert assessments is used to identify the ideal values of previously defined indicators.

5. Processing and analyzing the results, performing the relevant calculations. The results are processed as follows:

— The data obtained from each expert is used to calculate the arithmetic mean value of each indicator and is entered in the columns with ideal values in the summary tables;

— The results should be analyzed by comparing actual and ideal values. If the actual values differ from ideal values by more than 3 %, it is necessary to make appropriate changes in the existing structure of knowledge generation.

6. Defining the main stages in an integrated model of resource allocation for knowledge generation.

Model Description

Based on seven stages of product lifecycle and existing traditional four types of resources, we have developed a method for determining the horizontal resource potential of knowledge generation at the n-th stage.

This method allows to determine the potential for using the resources at each stage of the product lifecycle, as well as to reallocate and ensure the most efficient use of resources within each stage.

Based on previous studies [38], the horizontal resource potential for knowledge generation at the *n*-th stage of the product lifecycle can be calculated by using the following formula of additive summands with weighted coefficients:

$$P_n = k_1K_n + k_2L_n + k_3M_n + k_4I_n, \quad (6)$$

where K_n is financial resources at the *n*-th stage of knowledge generation; L_n is labor resources at the *n*-th stage; M_n is material resources at the *n*-th stage; I_n is information resources at the *n*-th stage.

To assess a specific type of resources, we need to determine the following:

1) Accrued wages normalized to the number of employees participating in the performance of specific phase (stage) of the product lifecycle;

2) Share of labor resources at each stage of the product lifecycle, by equating it to the share of employees responsible for performance of that stage;

3) Allocation of material resources based on the cost component of technical re-equipment plan for each stage of the product lifecycle normalized across the technical re-equipment plan;

4) Share of information resources by the share of information and computer resource provision at each stage of the product lifecycle.

The comparison of actual and theoretical values of horizontal resource potential will allow to adjust the allocation of share held by each of the resources within the stage, and thereby optimize the implementation of tasks at a particular stage.

Research Procedure

To assess the real resource potential of knowledge generation, we used the data on production activities in one of the large state-owned enterprises of the regional military-industrial sector for 2015.

In accordance with the stages of product lifecycle, we measured the actual data on the use of resources at each stage and compared it with the ideal values.

To obtain the ideal values of resource allocation, we surveyed top and middle managers at the level of Deputy General Director.

The actual measurement represents accurate data because, at this enterprise, each stage of the product lifecycle is performed by different units.

To assess the financial resources, we determined the accrued wages normalized to the number of employees participating in the performance of specific phase (stage) of the product lifecycle. We equated the share of labor resources at each stage of the product lifecycle to the share of employees responsible for the performance of that stage. To address the issue of individual differences in the abilities and skills of employees, during the study we considered only those who meet the qualification requirements for employees involved in R&D activities in the enterprises of the military-industrial sector. In addition, to improve the qualifications of employees included in the study, we considered only those research teams that did not allow the violations of deadlines and quality standards established for scientific and technical works in the enterprises of the military-industrial sector during the performance of state order, which indicates high qualifications of the considered labor force. We determined the allocation of material resources based on the cost component of technical re-equipment plan for each stage of the product lifecycle normalized across the technical re-equipment plan. We assessed the share of information resources by the share of information and computer resource provision at each stage of the product lifecycle.

The percentage ratios of financial, labor, material and information resources obtained by phases of product manufacturing were subsequently normalized for each phase in order to obtain the allocation of resources at each stage of the product lifecycle.

To support the proposed methodology for the enterprises of the regional military-industrial sector, the authors provided the institutional spiral of knowledge generation during the performance of state order (Fig.).

The proposed institutional spiral of knowledge generation during the performance of state order (Fig.) helps to improve the efficiency at each stage.

The first stage includes market research, preparation of documents for participation in various tenders and competitive biddings. Obtaining a state order is the prerequisite for transition to the second stage. The use of such institution as primary market research for purchased materials and components allows to significantly improve their quality in connection with the institutional approach to the analysis of marketing and tender documentation. The use of such institution as the market analysis improves the quality of research for potential areas in manufacturing new products and, as a result, expands the opportunities for participating in larger and most interesting projects. When the institutional design is used at the first stage, this allows to reduce the time for obtaining the orders and expands the opportunities for participating in the projects on more favorable terms.

The second stage includes preparation of technical specifications, research documentation, and simulation. The prepared preliminary design, technical proposals and scientific and technical report allow to make the transition to the next stage. The use of such institution as design management

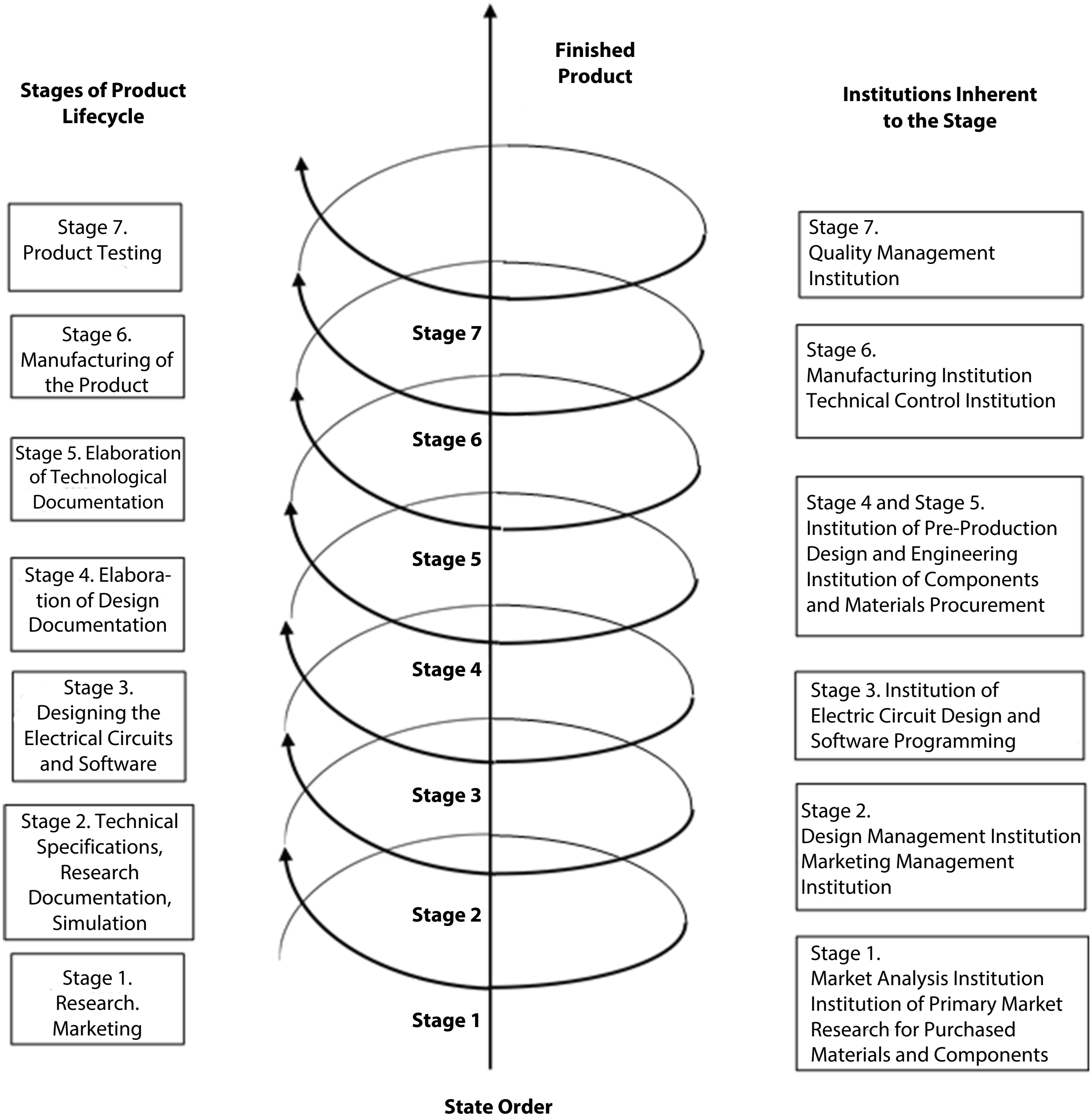

Fig. *The institutional spiral of knowledge generation during the performance of state order*

reduces the period of R&D works, improves their accuracy, and increases the probability of establishing more leading enterprise-wide standards. The use of such institution as marketing management allows to reduce the time for issuing technical proposals to research the component market. The use of such institution as knowledge generation results in improved accuracy of technical specifications, lower likelihood of errors in the subsequent stages.

The third stage includes the design of electrical circuits and software. Accordingly, completed computer programs and electric circuit designs prepared in the form of technical reports and procedures are required to make the transition to the fourth and fifth stages. The use of such institute as the electric circuit design and software programming reduces the time for designing electrical circuits and writing computer programs.

The fourth and fifth stages include the elaboration of design and technological documentation. A complete system of pre-production design and engineering in the form of technical reports, standards, conditions, and described technological processes is a prerequisite for transition to the sixth stage. The use of such institute as the pre-production design and engineering allows to increase the number of newly created technologies that improve the efficiency of manufacturing. The use of such institute as the purchase of components improves the quality of supplied materials. The introduction of knowledge generation institutions improves the accuracy in designing and describing the product manufacturing technology and reduces the likelihood of errors in manufacturing.

The sixth stage includes manufacturing the product, the completion and appropriate quality of which are the prerequisites for the transition to the seventh stage. The use of such institution as the manufacturing allows to reallocate and improve the efficiency of manufacturing capacity and labor, reduces the time for mastering new equipment. The introduction of such institution as the technical control improves the accuracy of technological processes. The use of knowledge generation institutions improves the reliability of manufactured products and reduces the number of defects.

The seventh stage includes testing of the product both in standalone mode and at the site of its use, and beginning of its trial operation. The outcome of this stage is the successful commissioning and acceptance of the finished products. The use of such institution as the quality management allows to exclude accidental changes to manufactured products. The use of knowledge generation institution reduces the commissioning period and the number of warranty repairs.

In general, the implementation of institutional knowledge generation spiral in the enterprises of the military-industrial sector reduces the level of uncertainty throughout the entire product lifecycle and, as a result, shortens the period of works and improves their quality, which inevitably leads to higher efficiency in the performance of state order.

Results of Empirical Research

The above method was used to study the knowledge generation system in one of the enterprises of the military-industrial sector, which allowed to obtain the ideal and empirical values of the horizontal allocation of resources across the stages of product lifecycle (Table 1). It should be noted that, according to the respondents, the ideal allocation of resources is optimal for the operations of the enterprises of the military-industrial sector and does not depend on a particular state order.

Table 1

The ideal (I) and empirical (E) shares of values for the elements of the horizontal resource potential of knowledge generation (%)

Stages of product lifecycle	Horizontal distribution of resources									
	Labor		Financial		Material		Information		Total	
	I	E	I	E	I	E	I	E	I	E
Research, Marketing	50	24	15	23	30	15	5	38	100	100
Simulation	50	23	20	26	20	11	10	40	100	100
Software	40	20	20	16	30	32	10	32	100	100
Designing	40	21	15	21	35	5	10	53	100	100
Development of technologies	40	30	15	31	40	9	5	30	100	100
Product manufacturing	25	28	25	31	10	27	40	14	100	100
Product testing	15	28	40	27	20	22	25	23	100	100

A comparison of empirical data and weighted coefficients of the theoretical horizontal potential for using the resources shows significant deviations between the actual and theoretical values for the share of resources used at each stage of the product lifecycle.

The stage of research and marketing analysis revealed a significant reallocation of resources to increase the share of information and financial resources. The second stage of the product lifecycle — the stage of preparing technical specification, research documentation and simulation — saw a significant increase in the share of material and financial resources compared to theoretical estimates, but also a significant reduction in the use of labor resources.

When analyzing the third stage of the product lifecycle — the design of electrical circuits and software — we observed the reallocation of resources towards the material and information resources; moreover, the use of information resources more than tripled compared to theoretical estimates. At the same time, the use of labor resources decreased twofold compared to the theoretical model.

When studying the fourth stage of the product lifecycle — elaboration of design documentation — we observed the reallocation of resources towards material resources. At the same time, there was a noticeable decline in the actual use of labor and information resources compared to theoretical model estimates.

When analyzing the fifth stage of the product lifecycle — elaboration of technological documentation — we observed the reallocation of resources towards a significant increase in the share of financial and information resources. Apparently, these processes reflect the reduction in the use of labor and material resources at this stage of the product lifecycle.

The sixth stage of the product lifecycle — the manufacturing of the product — involves higher usage of labor and financial resources compared to theoretical estimates, but uses less information resources.

The analysis of the seventh stage of the product lifecycle — product testing — revealed the reallocation of resources towards the higher use of the labor force compared to theoretical estimates. At the same time, there was a lower use of financial resources.

The comparison of theoretical (potential) and actual estimates indicates that there are reserves in developing the knowledge generation for the real-world manufacturing process.

Areas for Optimal Use of Resources

The analysis of empirical data allows to define the areas for optimizing the use of each type of resources at every stage of the product lifecycle.

At the first stage of the lifecycle, when conducting the research and marketing analysis, it would be appropriate to consider the possibility of reducing the use of labor and material resources. It can be assumed that a preliminary expert assessment of the share allocated for the use of these resources would be preferable. In other words, the issues of research and marketing analysis for the future product could be addressed by using less personnel and less equipment.

At the second stage, when elaborating technical specifications and research documentation, it is necessary to ensure a significant reduction in the share of material resources, perhaps by increasing the number of employees or improving the quality of staff. This is quite possible, as we have observed a significant reduction in the actual use of labor resources compared to its theoretical estimate.

During the third phase — design of electrical circuits and software — it is necessary to decrease the share of information resources, again by increasing the number of personnel and improving the quality of work with the personnel. It should be noted that a threefold difference between the theoretical estimate and actual use of information resources makes relevant the task of optimizing the information activities when implementing the third stage of the product lifecycle.

At the fourth stage of the product lifecycle — elaboration of design documentation — the effectiveness of knowledge generation can be accelerated by the significant reduction in the share of material resources, as well as by some increase in the use of information resources, the actual significance of which is well below the model level.

At the fifth stage — elaboration of technological documentation — it is advisable to reduce the share of financial and information resources. This could be ensured by increasing the use of labor and material resources. In other words, the financial savings could be achieved by optimal reallocation of efforts in implementing the fifth stage of the product lifecycle.

At the sixth stage of the lifecycle — manufacturing of the product — a slight decrease in the labor, financial and material resources by increasing the share of information resources will lead to optimization of the knowledge generation processes.

The analysis of resource allocation at the seventh stage — product testing — reveals the need to reduce the share of labor force with a possible increase in the use of financial resources. This is all the more possible, since the actual level of use of labor resources at this stage exceeds almost twofold the theoretical estimate of the labor contribution to completing this stage of the product lifecycle.

The identified areas for optimizing the use of resources at each stage of the product lifecycle allow to make savings and ensure the most efficient use of each type of resources.

Conclusion

The elaboration of integrated method to generate knowledge in the enterprises of the regional military-industrial sector as a set of resources and capabilities of enterprises in implementing the intellectual activity has lead to the following theoretical and practical results.

First, a theoretical methodology that allows to assess the capabilities of the enterprise in implementing the intellectual activity has been proposed.

Second, the institutional knowledge generation spiral in the performance of state order has been designed, the implementation of which reduces the level of uncertainty throughout the entire product lifecycle and, as a result, shortens the period of works and improves their quality, which inevitably leads to higher efficiency in the performance of state order.

Third, based on the empirical research the real shares of resource allocation at each stage of the product lifecycle have been determined for a large manufacturing enterprise of the regional military-industrial sector.

The comparison of theoretical and actual resource potentials of knowledge generation has made it possible to determine the areas for optimizing the use of resources to provide savings and ensure the most efficient resource provision for effective development and manufacturing of new products.

The proposed methodology, which is based on the use of resource potential to improve the efficiency of knowledge generation in the enterprises of the military-industrial sector as an engine of regional innovation activity, allows to improve the efficiency of knowledge generation in the enterprises of the military-industrial sector and, accordingly, increase the level of innovation development in the regions. The theoretical significance of this study lies in the development of a methodology for assessing the efficiency of knowledge generation in the enterprises of the military-industrial sector. The practical significance of this study lies in the possibility of using the proposed methodology in the enterprises of the military-industrial sector in order to increase the efficiency of knowledge generation processes and optimize the use of various resources in the enterprises of the regional military-industrial sector.

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References

1. Dyatlov, S. A. & Selishcheva, T. A. (2009). Oboronno-promyshlennyy kompleks Rossii kak osnova dlya innovatsionnogo razvitiya ekonomiki strany [Russian military-industrial sector as a basis for innovation development of the national economy]. *Vestnik Omskogo universiteta [Bulletin of Omsk University], 4,* 6–20. (Series: Economics).

2. Saakyan, A. M. (2012). Stimulirovanie innovatsionnoy deyatelnosti predpriyatiy OPK. Printsipy i instrumenty vybora form [Providing incentives for innovation activities in the enterprises of military-industrial sector. Principles and tools for selecting the forms]. *Sovremennyye tekhnologii upravleniya [Modern technologies of management], 16,* 32–37.

3. Kuzmenko, M. A. (2008). Teoreticheskie osobennosti organizatsii intellektualnoy deyatelnosti, napravlennoy na sozdanie korporativnogo intellektualnogo kapitala v OPK [Theoretical characteristics of organization of the intellectual activity aimed at creating the corporate intellectual capital in the military-industrial sector]. *Izvestiya Irkutskoy gosudarstvennoy akademii [News of Irkutsk State Academy], 5,* 34–36.

4. Esaulov, V. N. (2012). 20 let raboty predpriyatiy OPK v rynochnoy ekonomike [20 years of operations of the enterprises of military-industrial sector in the market economy]. *Vestnik Tomskogo gosudarstvennogo universiteta [Bulletin of Tomsk State University], 3(19),* 11–18.

5. Karavaev, I. E. (2012). Sushchnost i osobennosti innovatsionnogo razvitiya predpriyatiy oboronno-promyshlennogo kompleksa v sovremennykh usloviyakh [The essence and characteristics of innovation development of enterprises of the military-industrial sector in today's environment]. *Rossiyskoye predprinimatelstvo [Russian entrepreneurship], 13(211),* 82–87.

6. Makarov, V. L. (2003). Ekonomika znaniy. Uroki dlya Rossii [Knowledge economy: lessons for Russia]. *Vestnik RAN [Bulletin of the Russian Academy of Sciences], 73(5),* 450–456.

7. Kleyner, G. B. (2005). Stanovlenie obshchestva znaniy v Rossii. Sotsialno-ekonomicheskie aspekty [The emergence of knowledge society in Russia: socio-economic aspects]. *Obshchestvennyye nauki i sovremennost [Social sciences and the present], 3,* 56–69.

8. Bogomolov, O. T. (2000). Rossiyskoy normoy dolzhna stat sotsialno-orientirovannaya rynochnaya ekonomika [Socially-oriented market economy should become a standard for Russia]. *Ekonomicheskaya nauka sovremennoy Rossii [Economic science of modern Russia], 5,* 37–40.

9. Bagrinovskiy, K. A. & Isaeva, M. K. (2002). Bazovaya model mekhanizma upravleniya tekhnologicheskim razvitiem [The base model of the mechanism for managing the technological development]. *Ekonomicheskaya nauka sovremennoy Rossii [Economic science of modern Russia], 3,* 31–39.

10. Makarov, V. L. & Kleyner, G. B. (2007). *Mikroekonomika znaniy [Microeconomics of knowledge].* Moscow: Ekonomika Publ., 204.

11. Schumpeter, J. (1947). *Captialism, Socialism and Democracy (2nd ed.).* London: Allen and Unwin, 431.

12. Loury, G. C. (1979). Market Structure and Innovation. *The Quarterly Journal of Economics, 93(3),* 395–410.

13. Lee, T. & Wilde, L. L. (1980). Market Structure and Innovation: A Reformulation. *The Quarterly Journal of Economics, 94(2),* 429–436.

14. Sah, R. & Stiglitz, J. (1987). The Invariance of Market Innovation to the Number of Firms. *The RAND Journal of Economics, 18(1),* 98–108.

15. Delbono, V. & Denicolo, V. (1991). Incentives to Innovate in a Cournot Oligopoly. *The Quarterly Journal of Economics, 106(3),* 951–961.

16. García-Manjón, J. V. & Romero-Merino, M. E. (2012). Research, Development, and Firm Growth. Empirical Evidence from European top R&D Spending Firms. *Research Policy, 41,* 1084–1092.

17. Dasgupta, P. & Maskin, E. (1987). The Simple Economics of Research Portfolios. *The Economic Journal, 97(387),* 581–595.

18. Harison, E. & Koski, H. (2009). Applying Open Innovation in Business Strategies: Evidence from Finnish Software Firms. *Research Policy, 39,* 351–359.

19. Dahlander, L. & Gann, D. M. (2010). How Open is Innovation? *Research Policy, 39,* 699–709.

20. Ferrary, M. (2011). Specialized Organizations and Ambidextrous Clusters in the Open Innovation Paradigm. *European Management Journal, 29,* 181–192.

21. Arrow, K. J. (1962). Economic Welfare and the Allocation of Resources for Invention. In: Nelson, R. R. (Ed.). *The Rate and Direction of Inventive Activity: Economic and Social Factors.* Princeton: Princeton University Press, 646 (619- 625).

22. Reinganum, J. F. (1983). Uncertain Innovation and the Persistence of Monopoly. *The American Economic Review, 73(4),* 741–748.

23. Teece, D. (2010). Business Models, Business Strategy and Innovation. *Long Range Planning, 43(1),* 172–194.

24. Festel, G. (2014). Reasons for Corporate Research and Development Spin-Outs — The Chemical and Pharmaceutical Industry as Example. *R&D Management, 44,* 398–408.

25. Scotchmer, S. (1991). Standing on the Shoulders of Giants: Cumulative Research and the Patent Law. *The Journal of Economic Perspectives, 5(1),* 29–41.

26. Denicolo, V. (2000). Two-Stage Patent Races and Patent Policy. *Rand Journal of Economics, 31,* 488–501.

27. O'Donoghue, T, Scotchmer, S. & Thisse, J. (1998). Patent Breadth, Patent Life, and the Pace of Technological Improvement. *Journal of Economics and Management Strategy, 7,* 1–32.

28. Hunt, R. (2004). Patentability, Industry Structure, and Innovation. *Journal of Industrial Economics, 52(3),* 401–425.

29. Grant, R. M. (1996). Prospering in Dynamically-Competitive Environments: Organizational Capability as Knowledge Integration. *Organization Science, 7(4),* 375–387.

30. March, J. G. (1991). Exploration and Exploitation in Organizational Leaning. *Organization Science, 2(1),* 71–87.

31. Bierly, P. & Chakrabarti, A. (1996). Generic Knowledge Strategies in the U.S. Pharmaceutical Industry. *Strategic Management Journal, 17 (Winter Special Issue),* 123–135.

32. Hamel, G. & Prahaland, C. K. (1994). *Competing for the Future.* Boston: Harvard Business School Press. MA, 20.

33. Nekipelov, A. D., Tatarkin, A. I. & Popov, E. V. (2011). Imperativy sovremennoy ekonomicheskoy teorii [The imperatives of modern economic theory]. *Vestnik RAN [Bulletin of RAS], 81(2),* 169–174.

34. Padalkin, V. Yu. & Vorontsova, E. I. (2012). Ispolzovanie metodov analiza finansovykh rezultatov dlya otsenki ustoychivogo razvitiya ekonomiki predpriyatiy OPK [Using the methods of financial performance analysis to assess the sustainable development of economics in the enterprises of military-industrial sector]. *Teoriya i tekhnika radiosvyazi [Theory and equipment of radio communication], 4,* 119–123.

35. Batkovskiy, A. M., Trofimets, V. Ya. & Trofimets, E. N. (2014). Razvitie metodicheskogo apparata reytingovoy otsenki finansovo-ekonomicheskogo sostoyaniya predpriyatiy oboronno-promyshlennogo kompleksa. [Developing the methodological apparatus for rating assessment of financial and economic condition at the enterprises of the military-industrial sector]. *Finansy i kredit [Finances and credit], 48(624),* 34–45.

36. Shashkarova, M. V. (2015). Otsenka effektivnosti realizatsii innovatsionnykh proektov na predpriyatiyakh oboronnopromyshlennogo kompleksa [Assessing the effectiveness of innovative projects at the enterprises of the military-industrial sector]. *Innovatsii i investitsii [Innovations and investments], 5,* 10–13.

37. Namitulina, A. Z. & Kalashnikova, O. V. (2015). Osobennosti formirovaniya i ispolneniya federalnogo byudzheta v sfere oboronno-promyshlennogo kompleksa Rossii [The characteristics of formation and performance of the federal budget in the area of Russian military-industrial sector]. *MIR. Modernizatsiya. Innovatsii. Razvitie [MIR. Modernization. Innovation. Development], Vol. 6, 2(22),* 43–49.

38. Popov, E. V., Vlasov, M. V. & Shishkina, A. Yu. (2014). Prioritety generatsii znaniy na gosudarstvennykh predpriyatiyakh [Priorities of knowledge generation in state-owned enterprises]. *Natsionalnyye interesy. Prioritety i bezopasnost [National interests: priorities and safety], 26,* 2–11.

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