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Influence of innovative factors on the development process of modern multicomponent economic systems

Оптимизация трудовых процессов на инновационных предприятиях России

Influencia de factores innovadores en el proceso de desarrollo de sistemas económicos multicomponentes modernos

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Abstract

The article is devoted to the development of methods for the development of modern economic systems, taking into account the influence of various groups of innovative factors. The structural elements of the innovative economy and features of the stability of modern economic systems are revealed, and the main types of stability and ways to increase it are determined. The object of study is multicomponent economic systems are industrial enterprises that are directly affected by various innovative development factors. It has been determined that the increase in scientific and technical information through its acquisition in the production process involves the modernization of production and advanced training of workers, which in turn leads to a change in the factors of production. In Russia, the problem of investing in the innovation sector of the economy is now very urgent and is associated with a number of reasons: absence or weak development of the innovation infrastructure; distrust of potential investors in Russia and enterprises in its regions; need for significant modernization of the country's economy, technical and technological re-equipment of enterprises; lack of sectoral funding (especially R&D), etc. There is the technique that allows effectively carrying out various planning and innovative development processes at high-tech enterprises in modern economic conditions. It has been established that product technological innovations due to more efficient use of equipment, materials and partial changes in technology, make it possible to obtain an improved product.

Keywords: economic systems, innovative economy, innovative activity of enterprises, public-private partnership, innovative planning, high-tech enterprises.

Аннотация

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Статья посвящена разработке методики развития современных экономических систем с учетом влияния различных групп инновационных факторов. Раскрываются структурные элементы инновационной экономики, особенности устойчивости современных экономических систем, а также определяются основные виды устойчивости и способы ее повышения. Объектом изучения являются многокомпонентные экономические системы – промышленные предприятия, испытывающие на себе непосредственное воздействие различных инновационных факторов развития. Определено, что прирост научно-технической информации посредством ее приобретения в производственном процессе предполагает модернизацию производства и повышение квалификации работников, что в свою очередь приводит к изменению факторов производства. В России проблема инвестирования инновационного сектора экономики сейчас очень актуальна и связана с рядом причин: отсутствием или слабым развитием инновационной инфраструктуры; недоверием потенциальных инвесторов к России и предприятиям в ее регионах; необходимостью существенной модернизации экономики страны, технического и технологического перевооружения предприятий; нехваткой отраслевого финансирования – особенно сферы НИОКР и т.д. Предлагается методика, позволяющая эффективным образом осуществлять различные процессы планирования и инновационного развития на высокотехнологичных предприятиях в современных экономических условиях. Установлено, что продуктовые технологические инновации за счет более эффективного использования оборудования, материалов, частичного изменения технологии, позволяют получить усовершенствованный продукт.

Ключевые слова: экономические системы, инновационная экономика, инновационная деятельность предприятий, частно-государственное партнерство, инновационное планирование, высокотехнологичные предприятия.

Resumen

El artículo está dedicado al desarrollo de métodos para el desarrollo de sistemas económicos modernos, teniendo en cuenta la influencia de varios grupos de factores innovadores. Se revelan los elementos estructurales de la economía innovadora, las características de la sustentabilidad de los sistemas económicos modernos y se determinan los principales tipos de sustentabilidad y las formas de incrementarla. El objeto de estudio son los sistemas económicos multicomponente: empresas industriales que se ven directamente afectadas por diversos factores de desarrollo innovadores. Se ha determinado que el aumento de la información científica y técnica a través de su adquisición en el proceso productivo implica la modernización de la producción y la formación avanzada de los trabajadores, lo que a su vez conduce a un cambio en los factores de producción. En Rusia, el problema de invertir en el sector de la innovación de la economía es ahora muy urgente y está asociado con una serie de razones: la ausencia o el débil desarrollo de la infraestructura de innovación; desconfianza de los posibles inversores en Rusia y las empresas de sus regiones; la necesidad de una importante modernización de la economía del país, reequipamiento técnico y tecnológico de las empresas; falta de financiación sectorial, especialmente I + D, etc. Se propone una técnica que le permite llevar a cabo de manera efectiva varios procesos de planificación y desarrollo innovador en empresas de alta tecnología en condiciones económicas modernas. Se ha establecido que las innovaciones tecnológicas de los productos debido a

un uso más eficiente de los equipos, materiales, cambios parciales en la tecnología, permiten obtener un producto mejorado.

Palabras clave: sistemas económicos, economía innovadora, actividad innovadora de las empresas, asociación público-privada, planificación innovadora, empresas de alta tecnología.

Introduction

The study of modern aspects inherent in the development of complex social and economic systems in Russia leads to the conclusion that stability and long-term economic growth of the national economy is impossible without a comprehensive implementation of the innovation cycle. The structural composition of the cycle of innovation includes the following: organization and conduct of research; technology creation and development processes; organization of industrial production; entry and subsequent promotion of the created goods to the market; sale of innovative products. The practical implementation of the elements included in the innovation cycle has largely contributed to the formation of a close connection between science and real economy. The organization of such close cooperation made it possible to increase the intensity and effectiveness of various studies, improved the indicators of the stability of commercial structures to the norms of law in force in the country and in the field of intellectual property protection, etc. (Dzhuraev, Akhmatova & Teshaeva, 2015). It should be noted that almost any innovative economic activity that is carried out within the close boundaries of the designated economic system always has a certain level of impact on it. Consequently, the force and the vector of impact are in direct proportion to the current state in which the chosen economic system arrives at a given moment. Modern economic conditions that have developed in Russia, including the formed trend for the development of domestic enterprises, import substitution in a number of key industries, as well as a consistent increase in the level of competitiveness of Russian-made goods, etc., served as the main groups of factors contributing to innovative development (Kolosova, Sazonov & Vnuchkov, 2018).

Theoretical basis

At the moment, the vast majority of economic systems are in a certain transitional state, for example, the economic systems of developed high-tech countries are currently in a state of transition from an information society to an innovative one. We try to understand the concept of an innovative economy, and for this we will consider it from two semantic aspects. In the broadest sense of the concept, it is a certain combination of elements of technological structures and cycles of scientific and technological progress. In a narrow sense, the concept of an innovative economy is understood, as a rule, as a certain organization, in which the production basis is made up of high-tech products, as well as advanced materials and technologies and the corresponding social, organizational and economic structures (Astapov, 2005).

Innovation activity is a type of activity that implies the search and implementation of innovations in order to increase assortment, improve product quality, technology and organization of production. The main function of innovation is the function of change. I. Schumpeter noted five typical changes (Danilochkina, Sazonov & Zinchenko, 2018):

1. Use of new technology, technological processes or market support for production (purchase - sale).
2. Introduction of products with new properties.
3. Using new raw materials.
4. Changes in the organization of production and its material and technical support.
5. Emergence of new sales markets.

To increase the current indicator of innovative activity of domestic enterprises and their subsequent achievements of the key indicators indicated in the business plans in terms of innovative development, it is necessary to revise the measures in force in today's Russian economy to support and develop innovations. In the course of the study, factors influencing the innovative development of enterprises were identified and combined into groups.

First group. Factors determining the level of current innovative development, in terms of educational, scientific and technological aspects (Kuntzman, 2018):

- presence of a certain innovative potential of universities, which includes obtaining patents for various scientific developments, publications of conducted research, not only in leading Russian scientific journals, but also in foreign journals included in scientometric databases, such as Scopus, Web of Science (WoS), etc.

Second group. Factors determining the level of current innovative development in terms of regulatory and legal aspects (Maslova, 2019):

- degree of development of innovative activity, which includes the presence of strategies for the development of key industries, laws on the organization of innovative activities, targeted programs necessary for the effective development of innovations;
- availability of mechanisms aimed at assistance in obtaining patents, copyright protection, as well as improving the situation in the field of intellectual capital management of organizations.

Third group. Factors determining the level of current innovative development in terms of the organizational aspect (Porokhovsky, 2015):

- possibility of introducing modern methods necessary for the effective management of various production processes (including the use of mechanisms for the digitalization of a number of processes) in modern high-tech enterprises;
- application of outsourcing model, for example, for enterprises operating in the aviation industry.

Fourth group. Factors determining the level of current innovative development in the production aspect (Rakhimova, Kunanbaeva & Goncharenko, 2019):

- development of quality management systems for products manufactured by enterprises;
- availability of production and technological base that fully meets all the highest modern requirements for security and productivity, which is capable of functioning in a complex information environment at the industry level.

An innovative economy is based on a certain change in the combinations of various components embedded in the structure of production forces, i.e. for example, the implementation of the process of transition to a comprehensively automated type of production, as well as the direct development of products of a science-intensive nature. Of course, the innovative economy also includes mechanisms aimed at increasing various immaterial forms of society's wealth such as inventions, discoveries and, of course, rationalization, which ultimately leads to an increasing role of intellectual capital (Ministerio de Desarrollo EconómicoFederación Rusa, 2020). Analysis and assessment of the characteristics presented above, as well as other processes in the field of innovation, allows correctly understanding and studying the main groups and types of existing patterns and directions associated with transition processes in a modern economy.

Theoretical basis

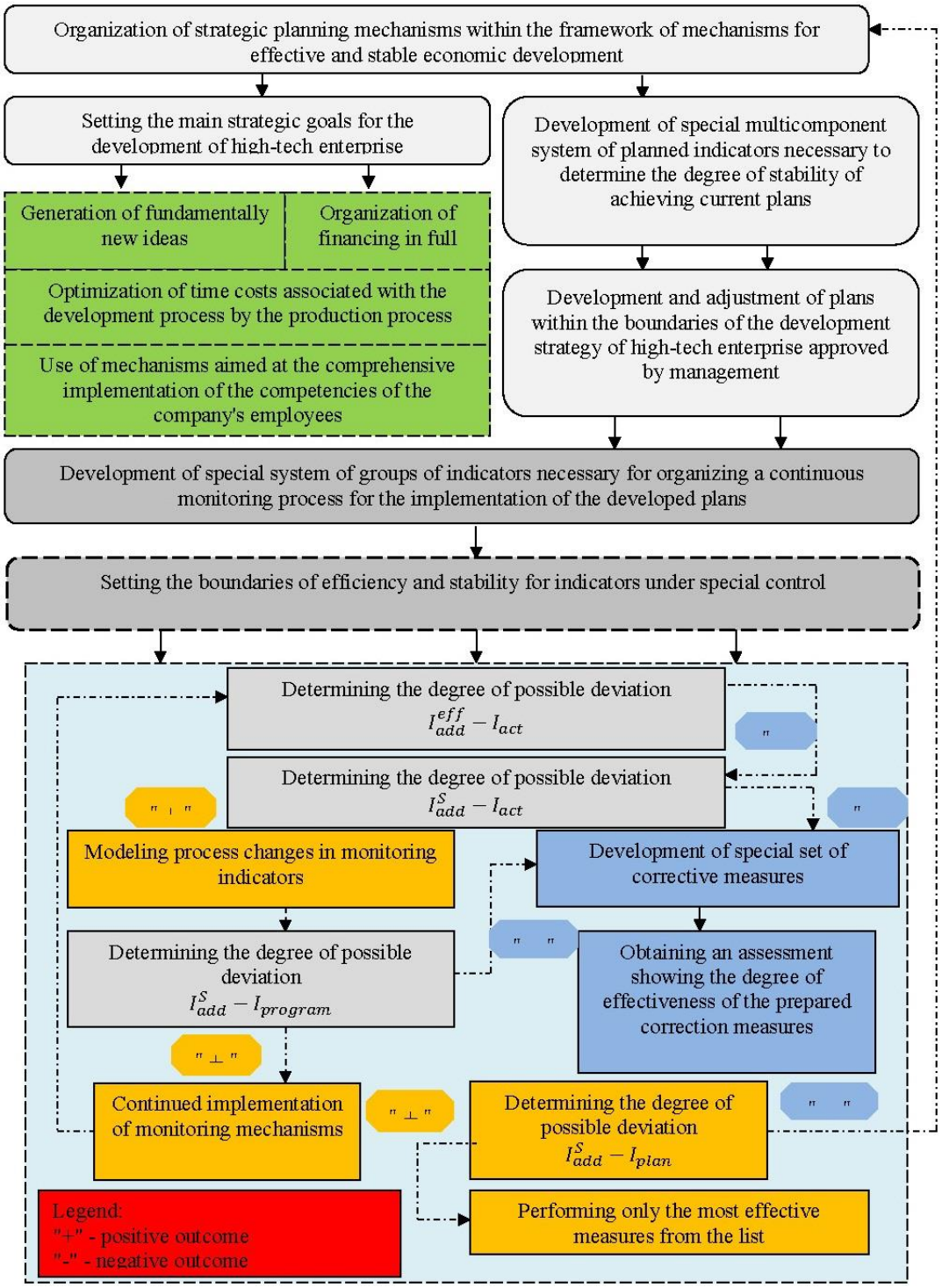
Modern economic systems have to a certain indicator of stability. Its concept in relation to economic systems means that the latter have a certain ability that allows them not only to achieve certain results (which have a low degree of possible deviations), but also to use unique recovery mechanisms if the system is influenced by negative factors. The simplest option for the stability of almost any economic system, of course, is the state of equilibrium, in which it stay, for a sufficiently long period, subject to the condition that it is not affected by any disturbing effect. We consider several types of stability (Razin, 2016):

1. Appearance of stability. This type is characterized by a certain degree of stability present in a certain economic environment, which has a certain degree of impact on a high-tech enterprise, while, in order to achieve a certain level of equilibrium in it, it is necessary to use management mechanisms throughout the whole country.
2. Internal view of stability. It represents a certain state of the enterprise, in which the overall level of its functioning increases, i.e. take into account changes in the structure of production affecting the types of provided services.
3. Stability with a hereditary appearance. It is characterized by the fact that the enterprise must have some reserves of financial stability, which have been successfully formed over the past several periods, which will allow the enterprise to significantly minimize possible negative changes in the external or internal environment.
4. Financial and economic type of stability. To a certain extent, it can be characterized by a level of financial stability, expressed, for example, in the degree of liquidity of assets, and the presence within the enterprise of the optimal combination of space-time relations.

Ensuring a stability level of development and functioning of an enterprise depends on a certain degree of development of a certain set of factors within the enterprise, such as: degree of flexibility and adaptation, as well as the level of innovation. This means that there is a definite need to organize procedures for planning the development of modern economic systems. For the stability development of planning processes within the enterprise, it is proposed to use the methodology for the formation of mechanisms for the stability and effective development of modern economic systems (Figure 1) (Ukhina, Agafonova & Polovinkin, 2016).

In order for economic systems to develop steadily, it is necessary that certain properties of self-organization are present within them, which means that the most general principles and properties can be identified that are characteristic of the elements included in the concept of innovative development (Saybel & Kosarev, 2018):

1. Economic systems combine the principles of openness and disequilibrium, i.e. there is a very large range of potential changes, which directly depends on the degree of changes occurring in the environment, and it should also be noted that disequilibrium manifests itself due to internal and external contradictions.
2. Stability can be effectively maintained through the use of resources, in other words, there is a certain pattern, which is that the degree of stability of the structure depends on how efficiently the resources are used.
3. Degree of uncertainty plays one of the key roles in innovative development, since the so-called wave character is inherent in economic processes, in other words, a huge number of processes and changes take place in the economy, for example, existing technological structures change or new points of economic growth arise.
4. Economic systems, as a rule, develop unevenly, and often their development depends on certain results obtained from innovative activities that take place within the enterprises themselves.



I_{act} – *system indicator of actual value;*
I_{add}^{eff} – *system indicator of efficiency of acceptable boundaries;*
I_{add}^{S} – *additional indicator of system stability;*
$I_{program}$ – *system programmable value;*
I_{plan} – *system planned value.*

Figure 1. Methodology for the formation of mechanisms for sustainable and effective development of modern economic system at high-tech Enterprise.

Results

The problem of investment and innovation is very urgent for the Russian economy, it is interconnected with the underdeveloped capital market. Funding for innovation often comes from the company's own funds, which are limited. As a consequence, this leads to the problem of financing innovation and the involvement and interest of the participants in the process. At the same time, it is necessary to involve not only the commercial sector, research and scientific organizations, but also the state in the process of investing in innovations. State activities can stimulate the growth of innovative activities, increasing the security of transactions and the attractiveness of this type of activity for investment, as well as guarantee the approach to the technological border of the country's economy as a whole, which ultimately will affect economic growth (Teslenko, Digilina & Kornilova, 2015).

Successful innovation activities of enterprises require cooperation of enterprises with scientific and research organizations, as well as the organization of clusters, whose activities are aimed at further innovative development. To train qualified personnel for innovative activities, appropriate educational institutions (higher education institutions, postgraduate studies and doctoral studies) are needed. The distribution of such establishments across the Russian Federation is uneven. But when considering the number of higher educational institutions and institutions of postgraduate education per population, the distribution of such educational institutions is relatively even, i.e. regardless of location (western or eastern part of the Russian Federation), most regions have the same potential for innovation.

So, investments and innovations are one of the main determining factors of economic growth in any country, as they contribute to the formation of an innovative economy. In Russia, the problem of investing in the innovative sector of the economy is now very urgent. It is associated with a number of reasons: absence or weak development of the innovation infrastructure; distrust of potential investors in Russia and enterprises in its regions; need for significant modernization of the country's economy, technical and technological re-equipment of enterprises; lack of sectoral funding (especially R&D), etc. This contributes to the need to develop a comprehensive state investment policy for the most innovative industries of the economy, education and science.

Discussion

Innovative activity of the enterprise is a certain set of measures aimed at the creation, acquisition, development and distribution of new or modernized types of products, services, technologies, raw materials, methods of organizing production and management. Innovation activity involves a whole range of scientific, technological, organizational, financial and commercial activities, which lead to innovation. When acquiring certain information, the enterprise compares the marginal usefulness of information and the marginal costs associated with its direct acquisition. The marginal utility of information can increase, decrease or be constant, as the marginal cost of acquiring it. If the marginal utility is shown to be higher than the marginal cost, it is certainly beneficial for the enterprise to buy additional units of information (Shutkov, 2019).

Information, being heterogeneous good, changes the operation of the law of marginal utility. The increase in scientific and technical information through its acquisition in the production process involves the modernization of production and the improvement of the qualifications of workers, which in turn leads to a change in the factors of production. If the marginal cost is higher than the marginal utility of information, it is not profitable for the enterprise to acquire information, but in this case, the costs of acquiring information are shifted to the total costs of the enterprise, which ultimately increase, reducing the gross profit of the enterprise. In this case, not every business can afford to purchase information. The decision to purchase additional units of information will not depend on the branch of the enterprise: in modern conditions, enterprises in industry, agriculture, services, trade, etc. are forced to acquire information for effective activity.

In a competitive environment, enterprise may occupy a certain market niche and not be interested in acquiring information. Enterprise, possessing a certain amount of information, makes a product (or service) that, despite the presence of competitors, may be in demand. Neither industry, nor enterprise's competitive environment or even favorable relation between the marginal cost of information and the marginal cost of acquiring will not be the main reasons for acquiring information. The main reason for the acquisition of information can be attributed to the desire of the enterprise, which can be dictated by various reasons. One of the main reasons can be attributed to the presence of a sufficient amount of financial resources for the company to acquire information (Chechina, 2015).

Conclusions

The positive impact of innovation on the life cycle of a technology is aimed at a more efficient use of this technology, increase in its life. The negative impact will primarily affect the life of the technology and additional costs aimed at improving or developing an alternative technology. But, on the other hand, the negative impact of innovation accelerates the replacement of the used technology, stimulates the development (or acquisition) of a new, more advanced technology at the moment, which allows to increase productivity, to produce a better product; which, in turn, requires additional investments in the development and in the acquisition of new equipment or technology.

In the economic development of any country, innovations play an important role, allowing the enterprise to apply various strategies that allow developing more new products and advanced technological methods of their production, which allows them to successfully compete in the market. Process technological innovations are aimed at mastering improved production methods that allow the use of new equipment and new technologies in order to obtain a new product. Product technological innovations due to more efficient use of equipment, materials, partial changes in technology, allow to get an improved product (Fedotova, Ilyasov & Tserenova, 2018).

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Modern innovative marketing technologies' practical tools analysis as a way to increase the high-technology enterprises' competitiveness

Анализ практического инструментария современных инновационных маркетинговых технологий как способ повышения конкурентоспособности высокотехнологичных предприятий

Análisis de herramientas prácticas de tecnologías de marketing modernas e innovadoras como una forma de aumentar la competitividad de las empresas de alta tecnología.

Andrey A. Sazonov[2]

Abstract

The article is devoted to the features' study of the modern innovative technologies use in the marketing sphere, in order to establish the possibilities that allow modern industrial enterprises to increase their competitiveness level. The authors highlighted the theoretical and methodological foundations for modern innovative technologies application in the marketing sphere necessary for organizing the integrated management process of enterprise's competitiveness indicators. The key features incident to modern marketing of innovations are determined. The lateral marketing improvement directions as a methodology for marketing approaches development and implementation in the company's activities to increase its efficiency in the competitive market environment formation for the production and sale of goods in modern economic conditions are considered. The main innovative marketing complex components are highlighted. The issues related to research in the innovative products' marketing research field and forecasting the markets' development are considered. The role played by modern marketing research in the scenario planning mechanisms' development is determined. The factors that can have a significant impact on the industrial enterprises' innovative activity indicators are structured. At the end of the article, the authors concluded that the current economic development level makes it possible to define innovation as a unique asset capable of qualitatively influencing the modern industrial enterprises' competitiveness main indicators, which in turn will lead to the fundamentally new products, services and technologies emergence.

Keywords: enterprise's competitiveness, industrial innovation, marketing of innovations, novelty marketing, technologies in innovation.

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Аннотация

Статья посвящена исследованию особенностей использования современных инновационных технологий в маркетинговой сфере с целью установления возможностей, позволяющих современным промышленным предприятиям повысить уровень своей конкурентоспособности. Авторами выделены теоретико-методологические основы применения современных инновационных технологий в маркетинговой сфере, необходимые для организации интегрированного процесса управления показателями конкурентоспособности предприятия. Определены ключевые особенности, присущие современному маркетингу инноваций. Рассмотрены направления совершенствования латерального маркетинга как методологии разработки и внедрения маркетинговых подходов в деятельность компании с целью повышения ее эффективности в условиях формирования конкурентной рыночной среды для производства и реализации товаров в современных экономических условиях. Выделены основные компоненты комплекса инновационного маркетинга. Рассмотрены вопросы, связанные с исследованиями в области маркетинговых исследований инновационной продукции и прогнозированием развития рынков сбыта. Определена роль современных маркетинговых исследований в развитии механизмов сценарного планирования. Структурированы факторы, которые могут оказать существенное влияние на показатели инновационной активности промышленных предприятий. В конце статьи авторы пришли к выводу, что современный уровень экономического развития позволяет определить инновацию как уникальный актив, способный качественно влиять на основные показатели конкурентоспособности современных промышленных предприятий, что в свою очередь приведет к появлению принципиально новых продуктов, услуг и технологий.

Ключевые слова: конкурентоспособность предприятия, маркетинг инноваций, маркетинг новизны, промышленные инновации, технологии в инновациях.

Resumen

El artículo está dedicado al estudio de las características del uso de tecnologías innovadoras modernas en el ámbito del marketing con el fin de establecer oportunidades que permitan a las empresas industriales modernas mejorar su competitividad. Los autores destacaron los fundamentos teóricos y metodológicos para la aplicación de tecnologías modernas e innovadoras en el ámbito del marketing, necesarias para organizar un proceso integrado de gestión de los indicadores de competitividad empresarial. Se han identificado las características clave inherentes al marketing moderno de innovaciones. Se consideran las direcciones de mejora del marketing lateral como metodología para el desarrollo e implementación de enfoques de marketing en las actividades de la empresa con el fin de incrementar su eficiencia en la formación de un entorno de mercado competitivo para la producción y venta de bienes en condiciones económicas modernas. Se destacan los principales componentes del complejo de marketing innovador. Se consideran las cuestiones relacionadas con la investigación en el campo de la investigación de mercados de productos innovadores y la previsión del desarrollo de los mercados de ventas. Se determina el papel de la investigación de mercados moderna en el desarrollo de mecanismos de planificación de escenarios. Se estructuran los factores que pueden tener un impacto significativo en los indicadores de actividad innovadora de

las empresas industriales. Al final del artículo, los autores llegaron a la conclusión de que el nivel actual de desarrollo económico permite definir la innovación como un activo único que puede influir cualitativamente en los principales indicadores de competitividad de las empresas industriales modernas, lo que a su vez conducirá al surgimiento de productos, servicios y tecnologías fundamentalmente nuevos.

Palabras clave: competitividad empresarial, marketing de innovación, marketing de novedad, innovación industrial, tecnología en innovación.

Introduction

The domestic and world economy development directly depends on what development stage the modern society is at. Currently, society is characterized by a significant increase in the degree of influence on it of various advanced and innovative technologies, as well as achievements' variety in the science field. World powers are successfully using various achievements in the high technologies field in order to achieve their economic, political and geopolitical goals.

Society has become more actively interested in the existing achievements in the high technologies field, which are then embodied in a variety of innovative goods and products. Ultimately, these goods' purchase and consumption by society contributes to the economy's development (Balashov, Lavrovskaya & Zheltenkov, 2014). To date, the main and most promising from an economic point of view direction for the high-tech innovations development in modern Russia are creating potential demand for various technological innovations, solving existing issues in the innovation, legal and personnel environment, and elements' modernization that make up the modern marketing complex.

These key mechanisms modernization ultimately forms the structural basis of marketing in the innovation field. Innovative marketing is necessary to establish the dependence degree, which can have two main factors on the market: the development level of scientific and technological progress (STP) and the existing needs of the innovations' end consumers. Then, modern innovative marketing can be understood as a certain type of enterprise's economic, financial, organizational and production activities, which is aimed not only at optimizing and increasing the current competitiveness level, but also at checking the enterprise for the possibility of fundamentally new and breakthrough technologies' timely introduction (Volod'ko, 2020).

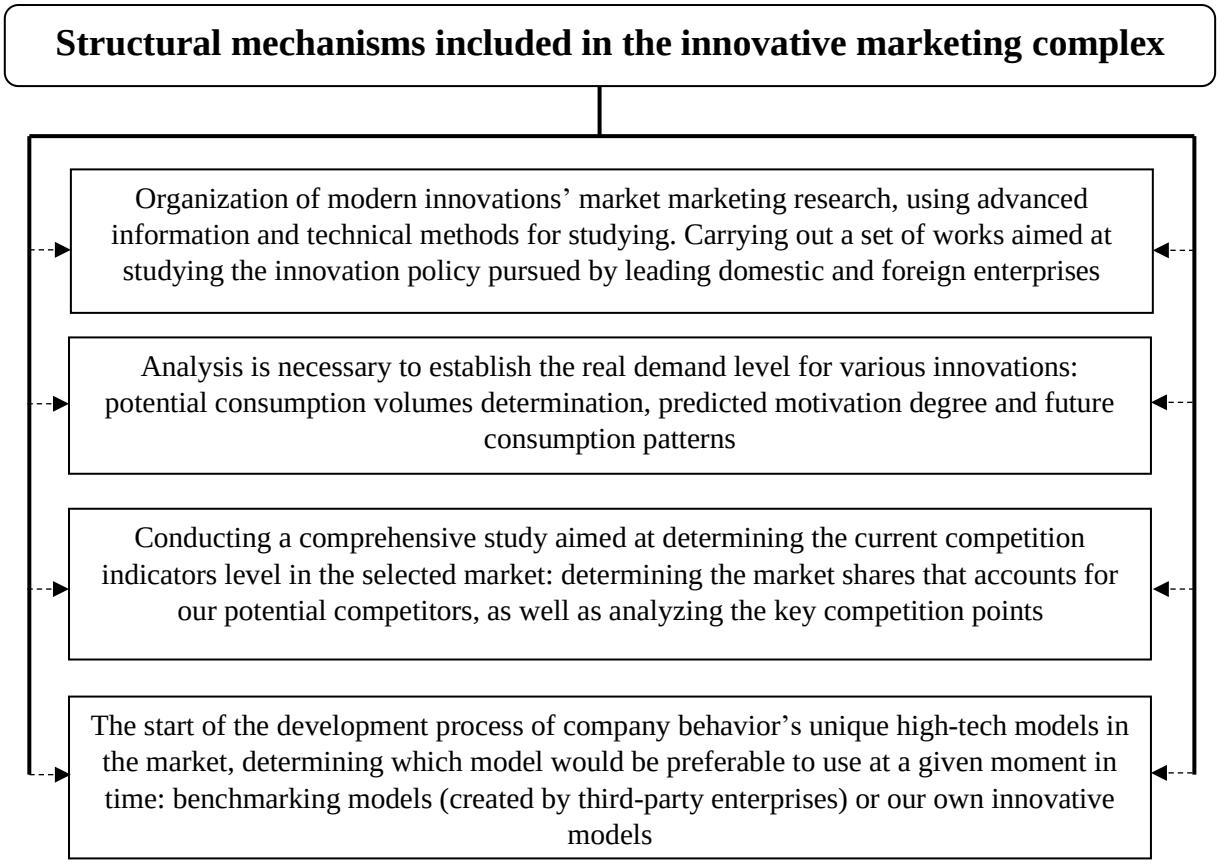
Theoretical basis

The growth of products' innovativeness, as a rule, is due to the homogeneity of the set of products and services provided on the market. As a result, companies try to create such a unique product or service that would be competitive. Unique new product's or service's creating issues is a rather complicated process and represents the implementation and improvement of the so-called lateral marketing, which is a new marketing development concept in the modern economy. According to F. Kotler, "lateral marketing is a method of searching for non-standard solutions that allow developing new products, finding new market niches and ultimately making a breakthrough in business" (Artamonova, 2016). The lateral marketing's essence is to search, on the marketing research basis, for a certain product or service that previously did not have a market niche

and were not in demand on the market by consumers. Lateral marketing methodology: an idea in the template form is laid in the innovative marketing basis in advance, which later becomes standard, and various ways of transforming it to improve the company's management efficiency as a whole. In this case, it is advisable to decide at the very beginning what needs to be changed and improved in a product or service in order to focus on the proposed idea implementation.

To date, a rather complicated social, economic and political situation has developed in the modern world, which in the most active way pushes domestic high-tech enterprises to the active and widespread introduction of various kinds of innovations in the marketing sphere. Modern marketing in the innovation field has the following distinctive features (Isakova, 2018):

1. There is a very long time period from the development process beginning to the actual use of the obtained high-tech products, and the results obtained from their use, as a rule, appear only in the future. Then the future product's competitiveness indicator will directly depend on the degree to which the direction of marketing research was correctly chosen, which was carried out during the period of scientific development work (D) (Zheltenkov & Yudin, 2017).
2. The final product's structural links composition also includes the product obtained as a result of the scientific and technical activities application, which means that when developing it, it is necessary to take into account the marketing efficiency degree, while the first product must take into account the currently existing marketing features that are inherent in the potential market. In other words, it is necessary to investigate in a detailed way the various changes that could occur in needs, not only in the final product, but also in the intellectual one. As a rule, marketing of a product of a scientific and technical type includes the collection process, as well as the subsequent analysis of the information received about its potential consumers' immediate area of work.
3. The inherent use value that is incident to any intellectual product is based on its unique ability to minimize labor and production costs. This means that marketing efforts complex should be aimed at analyzing and assessing this ability. Consequently, the intellectual product price level final indicator has a high dependence degree on how much labor costs have been optimized, than on the indicators of costs attributable to its direct development (Zheltenkov, Mottaeva & Kubrak, 2017).
4. The intellectual product has the ability to sell multiple times in different markets, to completely different end consumers, which means that distributing the created intellectual product method should be a priority task for its marketing campany (Kuznetsov, Romanovskaya & Khraban, 2017).

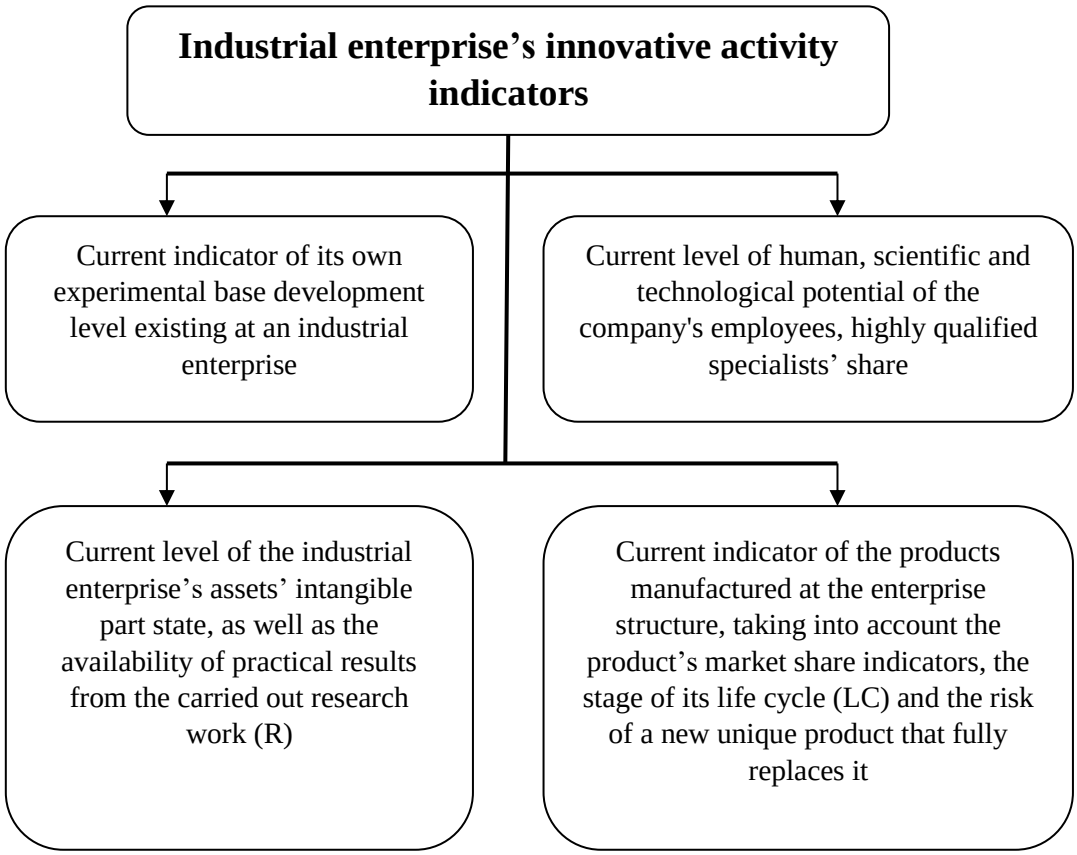


Compiled by the authors, based on practical developments

Figure 1. The main components included in the modern innovative marketing multicomponent complex.

Research part

The industrial enterprise's strategic and tactical orientation presented in a generalized form has a certain impact on the future innovative strategic system formation, which is necessary to take into account the multivariate marketing moves that the enterprise makes (Fig. 2) (Putyatina, Dzhamay & Lavrova, 2015).



Compiled by the authors, based on practical developments

Figure 2. Dominant groups of factors affecting the industrial enterprise's innovative activity indicators

The ability to withstand competition with similar competing goods is nothing more than the process of forming the competitive advantages of the goods sold on the consumer market [7, p.36]. In other words, the product's competitiveness is nothing more than a process based on a combination of all enterprise's resources efficiency usage and reducing production costs, on the one hand, and on the other hand, ensuring relatively low prices and goods' high quality that are in demand in the market and are quite profitably differs from similar competitors' products in terms of service level and satisfaction of the buyer's specific needs, while ensuring stability for the manufacturer in making profit and, on this basis, enterprises' sustainable development in the long term of their activities. In modern innovative marketing, specialists and experts group innovations into the following categories (Nadobnikov, 2012):

- pronounced radical nature innovations, means that these are unique brand new advanced technologies and products / goods. A characteristic feature of innovations of this nature is that they are usually limited and for their consumption a new sales market is formed with new consumers;
- innovations based on the combinatory principles, means that they are based on a certain combination of previously studied properties and elements. The direction vector of this innovation type is the process of attracting fundamentally new

consumer groups, or, for example, the development of a new (for an industrial enterprise) sales market;
- innovations based on modifications of a certain type, means that to a certain extent they complement the product already existing on the market. Typically, this type of innovation is aimed at strengthening or maintaining the industrial enterprise's current market position.

Innovative marketing deals not only with the study and market analysis, but the direct segments' formation on it, organizes, optimizes and forms future demand, which subsequently foresees the potential consumers' behavior. A special place in it is given to the moment when a new unique product appears on the market, its comprehensive studies and a forecast of its demand among potential consumers will be carried out (Novikov, 2018). Important points that should be considered by project managers in the innovation field are: the manufactured product's quality, its appearance and the groups of consumers who need this product. Innovative marketing is not limited by market research; it also collects and processes various information about consumers, for example, indicators of their income and ability to pay.

Innovative marketing technologies allow paying attention to the issues of studying various technological novelties' import and export, while the information necessary for this is taken from a large number of open statistical data, business and specialized journals, as well as from numerous chambers of commerce reports. By analyzing the buyers' current needs, and then dividing them into structured groups, i.e. by segmenting, one can easily determine a particular product's attractiveness degree, as well as the level of the product's current competitiveness. After successfully carrying out the above measures, it is possible to develop an effective strategy in the field of innovation, which will guide the industrial enterprise's marketing activities in the right way, which ultimately will speed up the implementation of the goals set in the enterprise's business plan (Podoprigora & Pivovarova, 2016).

Results

Innovative marketing is characterized by the presence of both price strategies and non-price strategies, with the following types of non-price strategies:

- "skimming" strategy as a rule is used in the process of implementing the innovative product to the consumer market, while the product has a fairly high price; this method works in the absence of company's competitors and lack of information about the product for consumers, as well as the need for quick profit;
- market penetration strategy, when relatively low prices are set for an innovative product, with a large number of competitors in the consumer market;
- prestigious prices strategy is applied subject to the new products' availability, taking into account the high quality and prestige achievement, that is, a situation is envisaged when a high price for consumers also means high quality products.

The domestic economy current development level considers the concept of innovation as one of the most effective means necessary to increase the industrial enterprises' competitiveness level, since the emergence of innovations leads to the emergence of unique and often even breakthrough technologies, services, goods and

products, which ultimately leads to the conquest of new sales markets by the enterprise. The innovative marketing practical value lies in the fact that it allows to determine the consumers' changing needs over time, monitor changes in demand indicators for manufactured products, as well as track and take into account, when formulating a future strategy, various changes in the competition field in the international market.

Thus, it can be concluded that the created product as a result of a lateral shift does not segment the market deeper, but creates a new one, that is, not a kind of product or service provided, but a completely new product that contributes to an increase in the company's rating and competitiveness and, as a result, gives the ability to capitalize the company's profitability as a whole. At the same time, lateral marketing sometimes contributes to the consumer fatigue formation from the constant innovations' implementation; the novelty of the product does not always cause increased interest, therefore it is advisable to provide a monitoring system in the process of implementing innovations in marketing, and when creating a new product or service and its usefulness for the consumer. Therefore, innovative marketing is the enterprise's activity, which is aimed at improving production and influencing the enterprise's market conditions.

Each innovation life cycle stage requires different methods and approaches, different marketing strategies and tactics. The system of innovative marketing measures is closely related not only to production renewal systems, but also to the dynamics of capital accumulation and overflow.

Discussion

To date, there is an intensified innovative development of various technical competencies, but without the use of technologies and marketing thinking methods, it will be impossible to achieve successful positioning of the created innovations on the market, even despite their unique technical and technological parameters. That is why, in modern market conditions, it is necessary to use various modern engineering marketing technologies, which is a scientific direction that allows an engineer to successfully make a variety of decisions in the areas of market research and technology, as well as to successfully solve organizational, economic, scientific and technical problems on a systematic basis. A properly organized marketing activity within the engineering activities' boundaries will be able to professionally determine the proposed innovations' feasibility and effectiveness, as well as facilitate the competent organization of expert engineering activities in the consistent development field of technological entrepreneurship mechanisms (Sorokin & Novikov, 2018).

Taking into account the Russian Federation's high-tech enterprises lag from developed countries' competitors, the state faces the need to stimulate and support innovative activity. In the context of the current economic and political sanctions limiting access to financial resources and advanced innovative technologies, this task is significantly complicated and supplemented by the import substitution program. At the moment, the Russian Federation state programs are divided into five key areas: "New quality of life"; "Innovative development and modernization of the economy"; "Effective State"; "Balanced Regional Development"; "Ensuring national security". Among these areas, the following programs and subprograms can be distinguished, aimed at supporting

and developing high-tech industries and innovative activities in Russia (Kuznetsov, Romanovskaya & Khraban, 2017):

- "Education development" program for 2013-2020, the budget is 4,134.3 billion rubles;
- "Development of Science and Technology" program for 2015-2024, the budget is 1,484.3 billion rubles;
- "Favorable investment environment formation" subprogram, the budget is 79.6 billion rubles;
- "Stimulating innovations" subprogram, the budget is 68.1 billion rubles;
- "Personnel for an innovative economy" subprogram, the budget is 3.9 billion rubles;
- "Creation and development of a multifunctional innovation center " Skolkovo" subprogram, the budget is 122.1 billion rubles;
- "Industrial development and its competitiveness increase" program, the budget is 1,061.1 billion rubles;
- "Development of the aviation industry" program for 2013-2025, the budget is 583.1 billion rubles;
- "Development of shipbuilding" program for 2013-2020, the budget is 314.4 billion rubles;
- "Information Society" program for 2011-2020", the budget is: 1,155.5 billion rubles;
- "Development of the transport system" program, the budget is 6,853.5 billion rubles.

One of the reasons is that in recent years, support for innovation and scientific and technological development in Russia has been aimed at creating scientific and technological groundwork, the commercialization of which will be possible only after the end of long R&D cycles. The fundamental task in drawing up an integrated marketing model is the need to attract a variety of investments at each stage of R&D, because the lack of ongoing funding is the most common reason for extending the timing of various studies. Of course, the attracting financial investments process is not the only task, because the developed marketing model is a kind of structural and logical framework for innovation, or high-tech project, which can draw attention to the benefits of R&D. The logical structuring of R&D assumes that a researcher at any time can make important adjustments to the goal, tasks or methods that are part of R&D (Podoprigora & Pivovarova, 2016).

Conclusions

The R&D organization marketing model is of high practical importance. The value for the developer lies not only in the ability to achieve the goals set at the beginning of the research, but also in the opportunity to convey their thoughts / ideas to specific target groups. From the point of view of groups of investors or creditors, the model being created significance lies in the fact that it will be an understandable informative form necessary for the project's presentation (Sazonov, Kolosova & Vnuchkov, 2018). The current product innovations' development level that the private sector is able to offer to various public corporations, other buyers and entrepreneurs lags significantly behind the indicators of the most developed countries. In addition, the Agency for Strategic

Initiatives (ASI) promoting new projects also notes that the process of managing various types of innovations within the framework of the state policy implementation was carried out with a large number of mistakes. A significant part of mistakes is often caused by a lack of the necessary experience and competencies in this area and by copying the best practices of developed countries without adapting to Russian conditions.

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Development of multi-component cost management system for organizing and conducting Research and Development

Разработка многокомпонентной системы управления затратами на организацию и проведение научно-исследовательских и опытно-конструкторских работ

Desarrollo de un sistema de gestión de costos de componentes múltiples para organizar y realizar trabajos de investigación y desarrollo

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Abstract

The article is devoted to the process of developing a multi-component cost management system for organizing and conducting Research and Development (R&D). The analysis of the current level of funding for science from funds allocated by the federal budget and funds provided by private organizations. The article discusses the concept of R&D as an integral object of management, clarifies the content of the concept of "cost management system for R&D". It is concluded that the modern cost management system for organizing and conducting R&D should be considered as a multi-level target information system. The goal of R&D cost management system has been determined, which is to optimize the size and structure of R&D costs in order to qualitatively improve the performance indicators of a high-tech enterprise by organizing R&D cost management. The author proposes a multicomponent cost management system for organizing and conducting R&D, based on the integration of various approaches, concepts and methods of organizing cost management in the implementation of basic management functions. The results of the research carried out in the article can be used as a theoretical basis for building a multicomponent cost management system in modern high-tech enterprises.

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Keywords: enterprise cost management, research and development, organization of planning in the field of research and development, cost accounting, intellectual property, regulatory costs, effective management of high-tech projects.

Аннотация

Статья посвящена процессу разработки многокомпонентной системы управления затратами на организацию и проведение НИОКР. Проведен анализ текущего уровня финансирования науки из средств выделяемых федеральным бюджетом и средств предоставляемых частными организациями. В статье рассмотрено понятие НИОКР как целостного объекта управления, уточнено содержание понятия «система управления затратами на проведение НИОКР». Сделан вывод, о том что современную систему управления затратами на организацию и проведение НИОКР следует рассматривать как многоуровневую целевую информационную систему. Определена цель системы управления затратами на НИОКР, которая заключается в проведении оптимизации размера и структуры затрат, приходящихся на НИОКР с целью качественного повышения показателей эффективности работы высокотехнологичного предприятия за счет организации управления затратами на НИОКР. Автором предложена многокомпонентная система управления затратами на организацию и проведение НИОКР, основанная на интеграции различных подходов, концепций и методов организации управления затратами при реализации основных управленческих функций. Результаты проведенного в статье исследования могут использоваться в качестве теоретической базы для построения многокомпонентной системы управления затратами на современных высокотехнологичных предприятиях.

Ключевые слова: управление затратами предприятия, проведение научно-исследовательских и опытно-конструкторских работ, организация планирования в сфере НИОКР, учет затрат, объект интеллектуальной собственности, нормативные затраты, эффективное управление высокотехнологичными проектами.

Resumen

El artículo está dedicado al proceso de desarrollo de un sistema de gestión de costos de componentes múltiples para organizar y realizar Investigación y Desarrollo (I + D). El análisis del nivel actual de financiación para la ciencia a partir de fondos asignados por el presupuesto federal y fondos proporcionados por organizaciones privadas. El artículo analiza el concepto de I + D como objeto integral de gestión, aclara el contenido del concepto de "sistema de gestión de costes para I + D". Se concluye que el moderno sistema de gestión de costos para organizar y realizar I + D debe considerarse como un sistema de información de objetivos de varios niveles. Se ha determinado el objetivo del sistema de gestión de costes de I + D, que es optimizar el tamaño y la estructura de los costes de I + D para mejorar cualitativamente los indicadores de rendimiento de una empresa de alta tecnología mediante la organización de la gestión de costes de I + D. El autor propone un sistema de gestión de costes multicomponente para organizar y realizar I + D, basado en la integración de varios enfoques, conceptos y métodos de organización de la gestión de costes en la implementación de funciones básicas de gestión. Los resultados de la investigación realizada en el artículo se pueden utilizar como base teórica para construir un sistema de gestión de costos multicomponente en empresas modernas

de alta tecnología. Palabras clave: gestión de costes empresariales, investigación y desarrollo, organización de la planificación en el campo de la investigación y el desarrollo, contabilidad de costes, propiedad intelectual, costes regulatorios, gestión eficaz de proyectos de alta tecnología.

Palabras clave: gestión de costes empresariales, investigación y desarrollo, organización de la planificación en el campo de la investigación y el desarrollo, contabilidad de costes, propiedad intelectual, costes regulatorios, gestión eficaz de proyectos de alta tecnología.

Introduction

Scientific and technological progress is a constant and continuous process taking place in two parallel areas: updating scientific knowledge and changing production technology, taking into account the nature of the operation of technological equipment. Scientific and technological progress has a significant impact on the entire production sector, qualitatively contributes to an active increase in labor productivity and the efficiency of the production process, accelerating the pace of social and economic development of the country. The result of the influence of scientific and technological progress on production and technological areas is innovation. At the turn of XX and XXI centuries, the role of innovations changed, which began to act as the main factor in the socio-economic development of countries, as well as a relation between innovations and the economic sphere. The modern stage of economic development is characterized by the influence of science on various reproduction processes. Developed countries and high-tech enterprises are systematically increasing funding for various R&D.

Innovative enterprises play a decisive role in the development of the Russian economy and make a significant contribution to the formation of GDP. For this, an innovative enterprise must have significant potential and maintain high rates of R&D at the level of world indicators, which is realized through: performing competitive R&D, effective management of results and accelerating their involvement in economic turnover. The creation of an effective organizational and economic mechanism for managing R&D is a necessary component of the success of an innovative high-tech enterprise (Bogacheva & Feoktistova, 2016). Eliminating the fragmentation of the management of the scientific space and increasing the level of integration of science and production, by involving the results of R&D in the economic turnover of an innovative enterprise are the most important conditions for the competitive development and financial and economic survival of an innovative industrial enterprise in the conditions of market relations. For effective management of R&D, it is necessary to offer complex procedures and solutions from the ordering stage to the use of the results. At the same time, the developed organizational and economic mechanism for R&D management should ensure a transition to more meaningful and high-level decision-making processes, accelerate and unify R&D management processes.

Literature Review

Russia lags behind the leading countries of the world in terms of the degree of funding for R&D, and the implementation of the national project "Science" practically does not change this situation, since the expenditures on science indicated in the framework of this national project are insufficient for the innovative development of the

economy. Experts from the Accounts Chamber analyzed the main reasons that, in their opinion, are holding back scientific development in Russia. To date, Russia is confidently ranked among the world scientific leaders in only one parameter: the absolute scale of employment in science. The number of Russian researchers in 2018 amounted to 514.7 thousand people, moreover, only in China (about 1.9 million people), USA (about 1.7 million people) and Japan (794 thousand people). Even if the target parameters are achieved within the framework of the national project "Science", spending on science in Russia will grow by 2024 to only 1.2% of GDP. In China, spending on science is about 2.2% of GDP, in the United States - 2.9% of GDP and in Germany - 3.0% of GDP (Kolesnik et al., 2015). We consider in more detail the main indicators showing the level of financing of modern Russian science (Table 1).

Table 1.
Structural composition of the main indicators of the level of financing of Russian science.

Considered indicator	2000	2010	2014	2015	2018
Federal budget appropriations for civil science, million rubles	17.5	238.7	438.1	439.6	460.2
Allocations that were allocated to civil science from the federal budget to the indicators of federal budget expenditures, %	1.70	2.36	2.97	2.81	2.99
Funds allocated to civil science from the federal budget to GDP indicators, %	0.24	0.53	0.57	0.55	0.70
Internal costs related to the organization of R&D, billion rubles	77.6	524.1	843.2	914.5	980.4
Internal costs attributable to the organization of R&D in % of current GDP	1.06	1.14	1.09	1.11	1.15
Internal costs attributable to various R&D activities by main sources of funding, i.e. at the expense of funds allocated by organizations belonging to the business sector, billion rubles	14.7	87.5	146.4	150.2	154.3
Internal costs associated with R&D in individual sectors of entrepreneurial activity, billion rubles	55.4	317.8	505.4	541.6	610.2

In the current conditions of the gradual transition of the Russian economy to a fundamentally new innovative path of development, there is a certain trend associated with an increase in demand for various high-tech products, which means that the development of competitive high-tech industrial products should become a priority task for high-tech enterprises. The amount of R&D costs is one of the main indicators that determines the degree of efficiency of scientific and technical activities carried out by the enterprise. The low economic efficiency of public and private investments in the development of science-intensive products is caused by a weak methodological base, the lack of effective tools and methods for managing the costs of organizing and conducting R&D at enterprises. It should be noted that R&D costs are the most difficult to manage and forecast. We consider the main factors that affect the value of innovation costs (Eremeeva, 2017):

- scale of the tasks to be solved;
- amount of costs increases proportionally depending on the current stage of innovation process;

- emerging need for the costs of related industries associated with the direct implementation of various innovative solutions;
- existing need to organize the transition to a fundamentally new technical principle of effective problem solving;
- size of the designed object;
- current level of tariffs, prices and rates for various types of resources that are used in innovation processes related to the implementation of organizational and legal actions;
- level of radicality of the proposed innovations;
- influence of the time factor on the accuracy of the planning process, depending on the timing of the project;
- level of development of tools and effectiveness of management of various types of costs.

Materials and Research Methods

The methodological and theoretical basis of the research is based on the works of Russian and foreign scientists. In the course of the research, the following methods were used: content analysis of regulatory and legal documents, analysis of fundamental and theoretical provisions presented in modern literary sources and systematic approach in the study of research problems (Kovyrzina & Guseva, 2019). The purpose of the research carried out in the article is to develop a multicomponent system for organizing and managing R&D costs of a high-tech enterprise, focused on high-quality and efficient use of a limited amount of resources, a qualitative increase in the level of competitiveness and competent solution of various strategic tasks.

The current problem in the field of cost management is very relevant and significant, therefore, Russian and foreign scientists conduct various scientific research in this subject area. Despite the huge range of scientific research in the field of cost management in scientific works, very little attention is paid to issues related to the formation of a cost management system in the field of R&D in modern high-tech enterprises (Komonov et al., 2018). In the course of the study, an analysis of special and scientific literature was carried out, including the study of special management practices for managing costs for Russian high-tech enterprises, which led to the conclusion that there was an insufficient degree of methodological and theoretical developments regarding the development of a multi-component R&D cost management system. The existing approach to organizing and managing costs at high-tech enterprises is characterized by unsystematic and fragmented nature, and those responsible for making managerial decisions do not have complete and accurate information about the level of R&D costs, which also affects the choice of the most effective managerial decision. The linear-functional structure applicable to most enterprises tends to best implement management functions such as accounting and planning, but other cost management functions are performed only partially or not represented at all (Peresypkina et al., 2017).

The cost management system for organizing and conducting R&D is a subsystem of the management system of a high-tech enterprise, in which the object of management is the costs that arise in the process of direct implementation of R&D, and the subject of management in this case is the heads of various levels. This system is focused on the implementation of a whole range of targeted actions in the field of optimizing the costs

of R&D, the formation of an information on current R&D costs for management entities, for a qualitative increase in the efficiency of the current activities of a high-tech enterprise, which is fully carried out scientific and technical activities. The proposed R&D cost management system should be considered as a single multicomponent information system, which is not only a management subsystem, but also interactions between various components. A cost management system for R&D is necessary to effectively optimize the structure and size of costs for organizing and conducting scientific research. We consider the structure of the mechanism for managing the costs of organizing and conducting R&D (Tretyakova et al., 2019):

- changes in the financial structure of a high-tech enterprise with the subsequent allocation of places where certain costs and centers of financial responsibility appear;
- design of information flows in order to ensure the continuous collection and transmission of information, which contains information about the current costs of R&D;
- R&D project should take into account the necessary costs for its implementation;
- accounting of costs by centers of financial responsibility and cost items;
- implementation of cost control in order to detect possible deviations of actual values from planned values;
- time analysis of cost structure changes, including benchmark analysis;
- making management decisions by the enterprise management.

A key distinctive feature of the system being developed for managing costs for organizing and conducting R&D is the presence in it of two objects of management: costs associated with product development and costs of product design at R&D stage. The model of R&D cost management system proposed in the article is based on the use of the "white box" model and is shown in the Figure 1. The proposed model of R&D cost management system describes the operation of three subsystems: control subsystem, which is the subject of management, controlled subsystem, which is the object management and subsystem of functions and connections. A multi-component R&D cost management system includes:

1. Conducting marketing research of the target costing market:

- target cost of the designed product has been determined:
- set the target cost of R&D.

2. Carrying out a technical and economic examination of the developed project based on the parametric method:
- forecasted cost of the designed product was determined.

3. Estimation of the cost of alternative options for the implementation of the project in the field of R&D based on the application of the calculation-expert method:

- determination of planned costs for alternative options for carrying out work in the field of R&D.

4. Assessment of the most effective options for conducting R&D based on the method of the most preferred option for performing R&D:

- most preferred R&D option has been identified.

5. Determination of limits for each stage and calculation items of the developed project in terms of R&D:

- approved limits for each specific stage and costing items.

6. Carrying out accounting for technological and scientific preparation of production based on the method of accounting for costs and limits for each separate stage and calculation items:

- actual costs required for R&D are determined.

7. Control over the costs associated with the implementation of technological and scientific preparation of production, based on the use of the method of current cost control:

- receiving data on changes and deviations in the established limits.

8. Analysis of current costs for technological and scientific preparation of production, based on the use of factor analysis and index method:

- identification of the culprits of deviations and making certain decisions on them.

9. Making a decision to start serial production of a standard-costing product developed at the enterprise:

- standard cost of the product for mass production has been determined.

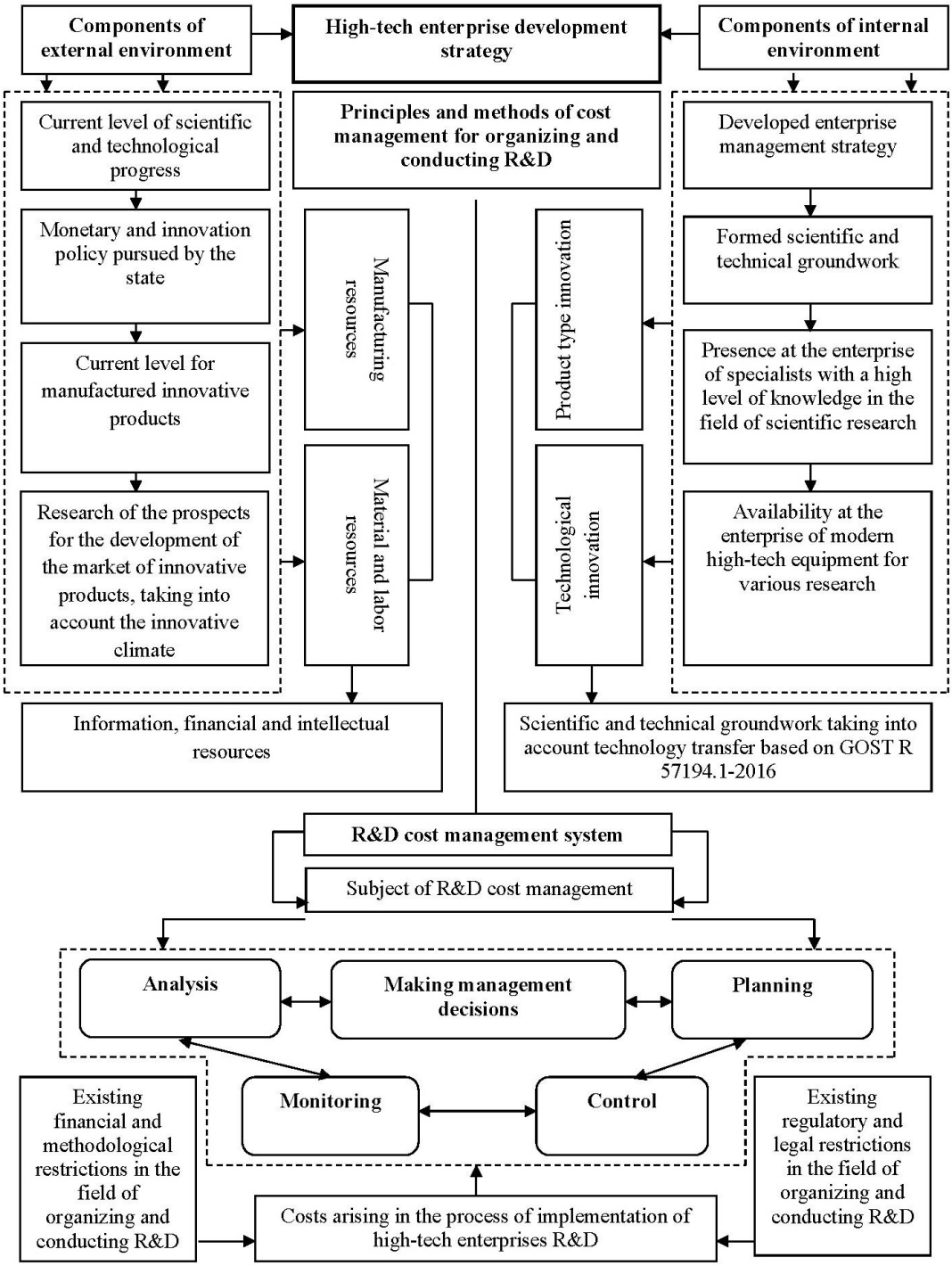

Figure 1. *Model of cost management system for organizing and conducting R&D.*

The proposed approach to creating a multicomponent cost management system for organizing and conducting R&D is based on the consistent integration of various approaches, concepts and methods of cost management, provided that the main management functions are consistently performed, namely, accounting, control, analysis and management decision-making (Pavlova & Muratova, 2018). The concept of "target-costing" is an effective method in the field of cost management, which allows the management of the enterprise to successfully implement the functions related to planning

and preventive control of the costs of the designed product and also allows the calculation of the target cost. Implementation of the "target-costing" concept in this system provides for its orientation towards two important indicators: target price of designed product and target cost of R&D project. Based on the obtained data on the target price of the designed product, the most preferable level of profit obtained from the sale of a new product is determined, and then the target cost of the product is determined, while the indicator of the target cost of the product is the maximum possible cost of the product. Carrying out a technical and economic examination of the project allows establishing the predicted cost of the designed product based on the use of the parametric method. If the indicator of the projected cost is higher than the indicator of the target cost, then it is necessary to determine the categories of costs to be optimized or reduced through the use of functional cost analysis. As a result of the application of the functional cost analysis, the target cost level should be achieved, but if this did not happen, then we need to go to the cost estimation stage and re-analyze the alternative project options in terms of R&D. Otherwise, the possibility of a complete refusal to carry out an R&D project is allowed (Novikov & Sazonov, 2020).

Results

Based on the data obtained on the projected sales volumes of the product developed at the enterprise and the requirements of the accounting policy, the target cost of R&D project is established. The indicator of the target cost of a project in the field of R&D is the maximum possible size for investment in R&D project under development, at which the profitability of the designed product is maintained. On the basis of the requirements for the designed product, which were set out in the terms of reference, options for the possible implementation of a project in the field of R&D are determined, taking into account the required amount of costs for their implementation. Then it is necessary to determine the most effective option for the implementation of R&D project, taking into account that its implementation is associated with indicators of economic efficiency, therefore, the indicator of the planned cost of alternative options for implementing R&D was less than / equal to the target cost of R&D, which was determined at the first stage. After choosing the optimal variant of the project in the field of R&D for its implementation on the basis of the schedule approved by the enterprise management, the process of allocating resources begins, taking into account the designated limits for each separate stage and calculation items. Organization of cost control in terms of R&D is proposed to be carried out on the basis of the use of the method of current control for the main changes and deviations. Before a decision is made to start a serial launch of a product developed at the enterprise, based on actual production data on the costs of R&D, the costs associated with the preparation of production and the development of the necessary technologies, it is necessary to clarify the indicators of the planned cost of production based on the "standard-costing" method. If the indicator of the planned cost of the product turns out to be less than or equal to the target indicator, then we need to make a decision on the start of serial production, otherwise we need to determine whether it is possible to achieve the target cost at the stage of serial production of the product, this can be done if we apply the concept "kaizen-costing". If the target cost cannot be reached at the stage of mass production, it is advisable to completely abandon the production of this type of product.

Conclusions

In modern conditions, when the Russian economy is switching to an innovative path of development, the process of enhancing the innovative activities of high-tech enterprises is the main condition for ensuring their survival in the face of intense competition. The main task that is set for Russian high-tech enterprises, which are actively engaged in the implementation of various R&D, is the creation and subsequent introduction into production of new unique types of science-intensive products. In these conditions, a special role is played by the organization of effective cost management for the organization and conduct of R&D within the enterprise. In conditions of insufficient funding for various R&D, enterprises need to carry out applied R&D only at their own expense. The proposed approach to the design of a multicomponent cost management system for organizing and conducting R&D is distinguished by the presence of an interconnected implementation of all basic management functions, as well as ensuring a stable relation between R&D cost management and the organization of cost management at all other stages of the product life cycle, this is achieved due to the presence of two objects cost management. The set of approaches, concepts and methods proposed in the article in the field of organizing R&D cost management will give a certain opportunity for the effective management of the scientific and technical activities of a high-tech enterprise, which will allow making high-quality management decisions at each separate stage of the implementation of proactive R&D.

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Perspectives of the development of digital transformation of economy and industrial complex in the Russian Federation

Перспективы развития цифровой трансформации экономики и промышленного комплекса в Российской Федерации

Perspectivas para el desarrollo de la transformación digital de la economía y el complejo industrial en la Federación de Rusia

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Abstract

The article is dedicated to reviewing dominant perspectives of developing of economics' digital transformation processes and industrial complex of the Russian Federation. The goal of the research, given in this article, is connected with the state of methodological approach to estimation of digital complex transformation process in terms of deep insight of digital technologies (DT) into real sector. Digital transformation of such poly-structural system with a significant number of vertical and horizontal connections, as Russian industrial complex, is a rather positive process, including some consecutive stages. There are defined priority blocks for actualization and increasing the strategy of digital transformation in 2021. There is consecutive process of making industrial complex digitalization process. There are typical profiles of digital companies' readiness. There are changes of organizational structure in digital transformation. There is a model of digital transformation on the basis of «Product-driven corporate transformation». We defined long-term perspectives of development of digital industry and economics' transformation in Russia Federation. In conclusion of the article the authors pointed out terms of reducing the break in technological and economical lag of the Russian Federation from other countries.

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Keywords: digital transformation, company development, industrial development, advanced technologies, digitalization of industrial complex, digital economy.

Аннотация

Статья посвящена рассмотрению доминантных перспектив развития процессов цифровой трансформации экономики и промышленного комплекса в Российской Федерации. Цель исследования, представленного в данной статье, связана с обоснованием методологического подхода к оценке процесса трансформации промышленного комплекса в условиях глубокого проникновения цифровых технологий в реальный сектор. Цифровое преобразование такой полиструктурной системы со значительным количеством вертикальных и горизонтальных связей, как российский промышленный комплекс, является достаточно продолжительным процессом, включающим в себя несколько последовательных стадий. Определены приоритетные блоки для актуализации и усиления стратегии цифровой трансформации в 2021 году. Рассмотрен последовательный процесс проведения процесса цифровизации промышленного комплекса. Выделены и проанализированы типовые профили цифровой готовности компаний. Охарактеризованы изменения организационной структуры при цифровой трансформации. Предложена модель цифровой трансформации на основе «Product-driven corporate transformation». Определены долгосрочные перспективы развития цифровой трансформации промышленности и экономики в Российской Федерации. В заключение статьи авторами обозначены условия сокращения разрыва в технологическом и экономическом отставании Российской Федерации от развитых стран.

Ключевые слова: цифровая трансформация, развитие компаний, индустриальное развитие, передовые технологии, цифровизация промышленного комплекса, цифровая экономика.

Resumen

El artículo está dedicado a revisar las perspectivas dominantes del desarrollo de los procesos de transformación digital de la economía y el complejo industrial de la Federación de Rusia. El objetivo de la investigación, dado en este artículo, está relacionado con el estado del enfoque metodológico para la estimación del proceso de transformación del complejo digital en términos de un conocimiento profundo de las tecnologías digitales (DT) en el sector real. La transformación digital de dicho sistema poliestructural con un número significativo de conexiones verticales y horizontales, como el complejo industrial ruso, es un proceso bastante positivo, que incluye algunas etapas consecutivas. Se definen bloques prioritarios para la actualización e incremento de la estrategia de transformación digital en 2021. Hay un proceso consecutivo de realización de un proceso complejo de digitalización industrial. Hay perfiles típicos de la preparación de las empresas digitales. Hay cambios de estructura organizativa en la transformación digital. Existe un modelo de transformación digital basado en la «transformación corporativa impulsada por el producto». Definimos las perspectivas a largo plazo del desarrollo de la industria digital y la transformación de la economía en la Federación de Rusia. Como conclusión del artículo, los autores señalaron los términos para reducir la

ruptura en el rezago tecnológico y económico de la Federación de Rusia con respecto a otros países.

Palabras clave: transformación digital, desarrollo empresarial, desarrollo industrial, tecnologías avanzadas, digitalización del complejo industrial, economía digital.

Introduction

A characteristic specialty of modern global world is getting DT in main life spheres. The trajectory of a breakthrough scientific, technological and socio-economic development of the Russian Federation should be considered within the framework of accelerating technological renewal, contributing to innovative growth. The trajectory of breakthrough scientifically-technological and socially-economic development of the Russian Federation should be considered in terms of increasing of technological update, which works for innovative growth. The world's economics is on the edge of new transformation. The continuing process of digitalization leads to changing of global economics due to reducing costs of collecting, storing, processing data; shortening production chains, etc. Changes of such kind, for sure, have an impact on demands, which are given to the level of workers' qualification and market participants representing business and government. The theme of building digital economics in Russia recently has become not only a subject of studies on the government and expert level, not only the most fashionable trend of public talks and the youngest federal program, but also a rather big problem, connected with its realization. Technological level of development of industrial production and structural distortions to the side of low-technological and ecologically disadvantaged sectors allow carefully accept prognoses about a comprehensive digitalization of the industry in the near future (Istomina, 2018).

The research goal, given in this article, is connected to stating methodological approach to estimation of the industrial complex transformation process in terms of deep insight of DT into real sector. Digital transformation of such poly-structural system with a significant number of vertical and horizontal connections, as Russian industrial complex, is a rather positive process, including some consecutive stages. Definition of stages of digital transformation of real sector will allow not only estimate a modern stage, but also predict perspectives of industry and economics' digitalization.

Literature Review

With digital economics we refer different types of economic activity, in which usage of digital information and knowledge plays a role of the main production factor, modern information networks become an important activity sphere and effective usage of informationally-communicative technologies (ICT) comes as an important moving force of increasing resulting and optimization of the economics' structure. For collecting, storing, analysis and changing of information, in digital format and changing the ways of social communication we used Internet, cloud calculations, big data, IoT, financial and other new DT. Due to computerized, networking and intellectual ICT, the modern economic activity is becoming more flexible, dynamic and overthought (Kryukova & Mikhalenko, 2017).

Nowadays the society cooperates with the "third wave" of digital transformation:

- First wave (1960-1970): digitalization and automation of separate types of activity in the chain of creating the cost, from orders' processing and payments the bills before automatized computer projecting and planning of production resources.
- Second wave (1980-1990): Internet and expanding of computer technologies allowed moving to intellectual productions and globally integrated chains of catering.
- Third wave (2000-2010): transition to "connected things", transformation of all production and social systems into cyber physical forms, change of "informational revolution" (1960-1990) into "intellectual revolution", formation of such known "Industry 4.0".

In 2010 most of industrially developed countries and a lot of developing countries (all in all 140 countries) made a decision about "digital transformation" and building "digital economics" on the basis of "Industry 4.0" of "IoT" ("Industrial Internet", "Global Internet", etc.), made national plans of developing ICT. The new industrialization is connected to creation of the forth global industrial revolution, creating forward-looking industrial and economic models using hybrid NBIC-technologies (nano-biotechnology, information technology, cognitive science), in which information technologies come as technologies-integrators. The transition from the third to the forth industrial revolution has a lot of analogies to the transition from the first to the second industrial revolution.

First of all, innovations are generated on the vertical (industrial) level, changing production and institutional relation inside the sphere. Later horizontal relations between made vertical innovations form new production business-models. During the third industrial revolution appears the sphere of electronics and ICT, having created the platform for developing global industrial networks, networking production and divided energy. This is why transition from the third to the forth industrial revolution is more an evolution, than revolution, because it is an inevitable transition from simple digitalization (the third industrial revolution) to innovations, on the basis of hybrid, convergent technologies (the forth industrial revolution), which result will be fully automated digital production, managed by intellectual systems in the regime of real time (Basaev, 2018). Goals (ambitions) in digital transformation in a significant degree define the content of digital transformation content, the portfolio of digital initiatives, the necessary investments in digital transformation and the effects achieved. Goals of different companies' digital transformation differ from implementing separate digital decisions to cultural transformation and creations of ecosystems. The typical goals of digital transformations are (Plotnikov, 2018):

1. Increasing of operational effectiveness. Reducing of self-cost, increasing of loyalty, providing the level of LP&IS (labor protection and industrial safety) and decision of other operational tasks due to implementing digital decisions.
2. Increasing of competitiveness of products and companies' services:

- Take away of new products (services), using DT;
- transition to new business-models, using DT for saving competitive positions of the company and/or for increasing the level of service (product's quality) for consumers.

3. Increasing of the business-decisions' quality and business transparency. The collection of new data and transition of existing data into digital format, and implementation of data analyzing tools for goals:

- companies' activities control;
- increasing of the quality of made business decisions and extension of human mistakes.

4. Realization of innovative projects on the basis of usage of DT. Development and implementation of innovative decisions on the basis of DT and company's data.
5. Increasing of the companies' "life-cycle". Digital, cultural, organizational and mostly operational transformation for qualitative company's changing ("digital company"):

- speed and flexibility of business processes and usage of resources;
- fast reaction on outer conditions' changes;
- focus on the customer.

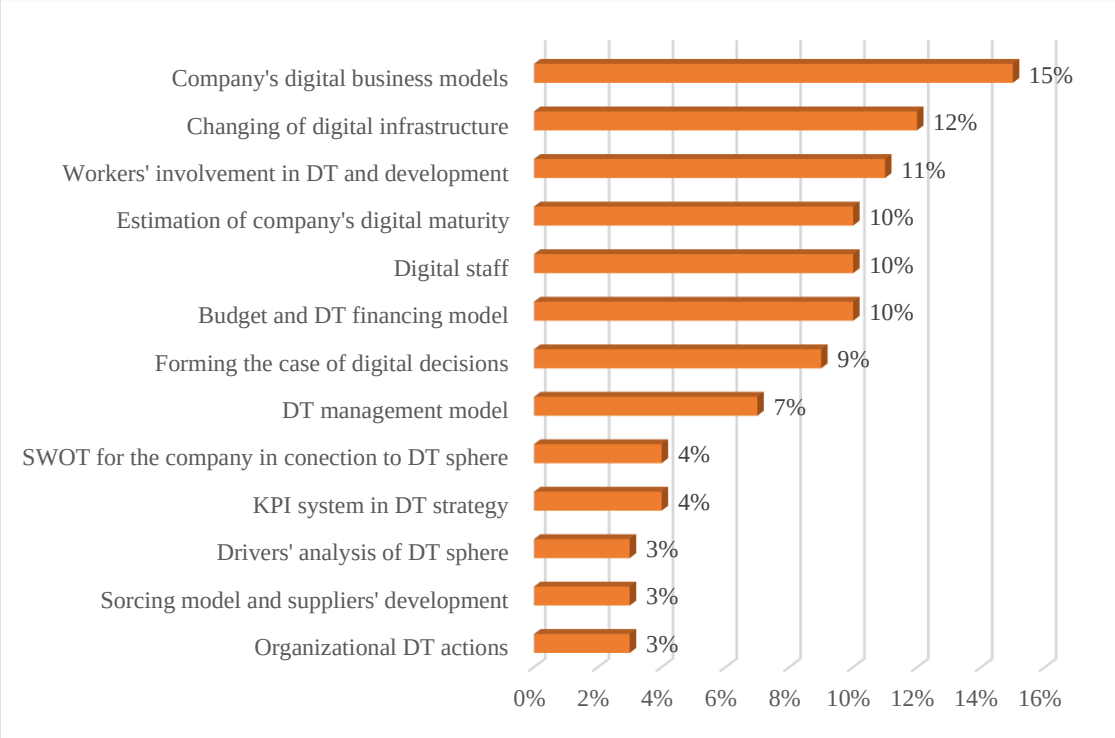
6. «Upgrade» of the company's business before ecosystem (platform). Monetization of existing client base of the company or technological platform through creating digital ecosystem.

Digitalization of industrial development supposes creation and development in the whole row of technologies, among which work over of big amount of data, industrial Internet, additive technologies, robotization, automatic collection of collecting and considering data, special indicators and management tools, etc. Such technologies in industrialization demand use pre-forecasting tools, explanations of uncertainties, making the most informed decisions. There are different changes in organizational structure of companies due to digitalization and transition to platform architecture (Akberdina, 2018). The main structures, providing the management process with changes, during digital transformation are (Novikov & Sazonov, 2020):

Digital Evangelist – responsible for creation digital content for all stages of digital transition of the clients (opening of digital decisions, education, testing operations, purchase, implementation, protection). Evangelist has to lead a job on the expert support and participation motivation in digital transition of internal companies' workers, partners' representors and society.

Digital Ambassador – responsible for opening new opportunities for clients and all players in digital economics (accepting digital business-models) in the form of alliances, co-companies, partnerships or activities for mutual learning and dialogue.

The strengthening digitalization processes, happening in the world, lead to deleting geographical and physical borders, which, without any doubt, open new opportunities for states, business and works for development of competitiveness inside countries (on regional state) and in the whole world (global state). The worlds' experience is showing: with the correct building of functioning mechanisms of digital economics, increasing, including regulatory and legal, it is possible to achieve significant economic growth, increase in labor productivity and the creation of new sectors. About 1/3 of the companies move from implementation of digital decisions to a wider digital transformation: implementation of new digital business models and products, work with digital cadres and cultures (Figure 1).



Source: Company Survey during Digital Transformation Workshop by Naumen and Strategy Partners

Figure 1. Priority blocks for actualization and increasing the strategy of digital transformation in 2021 (Strategy.ru, 2020a; Strategy.ru, 2020b)

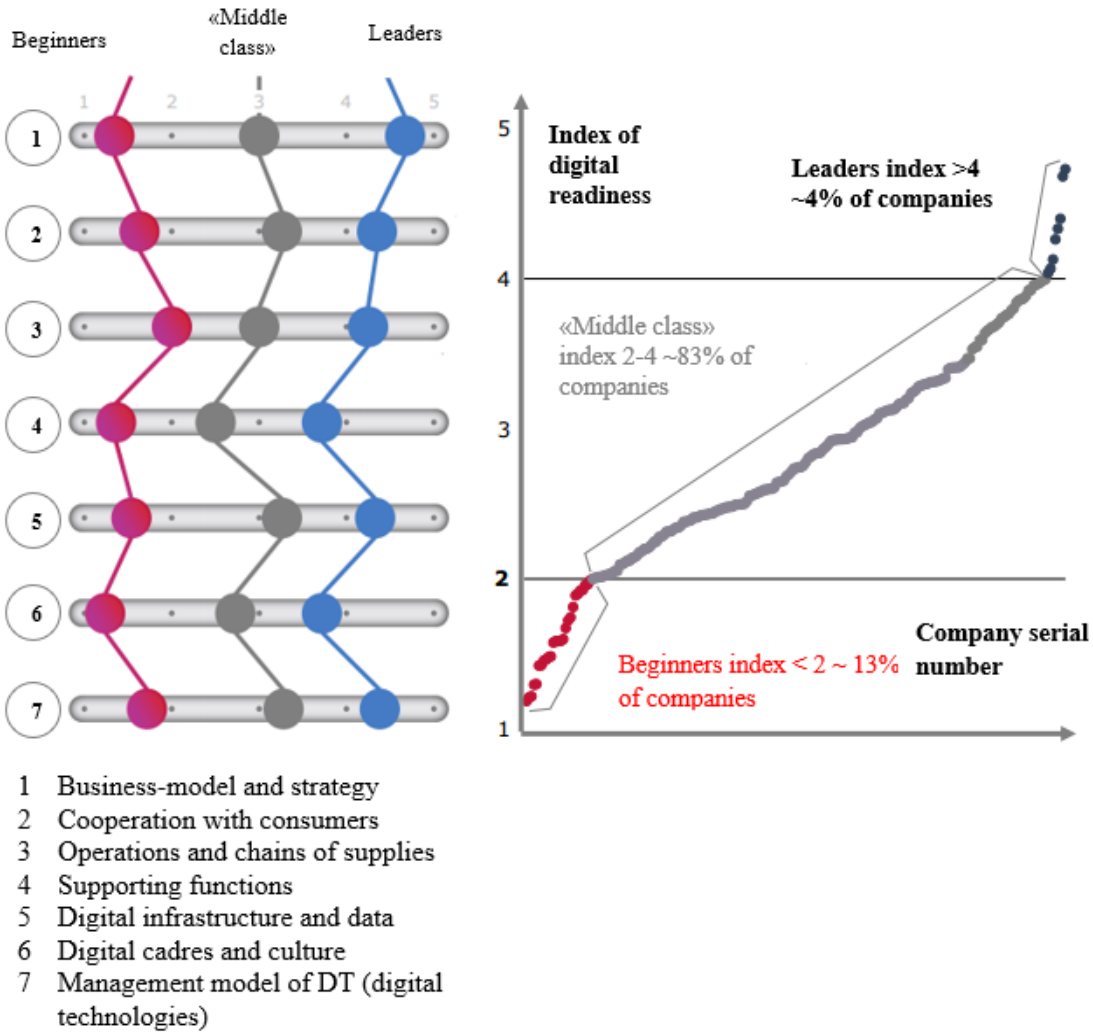
Materials and Research Methods

The process of industrial complex's transformation, caused by absolutely any factors and realized in any conditions, as a rule, always comes as discrete process of qualified changes, which lead to rather noticeable structural changes, and also defined institutional transformations. Pointing out of key stages of industrial complex came up with the necessity of staged analysis and estimation of qualified changes, which often have an irreversible character and form the transition in principally new condition with higher social and economic indicators of effectiveness on the way to forming future model of industry. Any qualified changing of the system connects with its structure changing, which leads to transformation of the existing forms of economic activity and socially-economic institutes. In such way of telling the concept "transformation" does not include the whole process of this transition preparation, which, as it is known, separates on different periods of quantity and quality transformations. In this case transformation is only the result of previous transformations, the moment of transformation, not the process of system's transformation. The authors suggest pointing out the main stages of transformation of industrial complex and show them as a table (Romanova, 2018).

Table 1.
Process of industrial complex digitalization.

First stage. Primary informationally-communicational digitalization	Computerization in the broadest sense of the word, large-scale introduction of electronic computers into the sphere of production in various industries. Computerization is a central and indispensable condition for the development of information interactions that determine industrial development
Second stage. Electronic exchange of data with electronic data interchange (EDI)	EDI, in conjunction with the Internet, enables real-time electronic transactions and thus significantly accelerates the interaction between suppliers, contractors, cooperators and consumers. The indicators characterizing this stage include: *part of enterprises, using EDI by the formats of exchange (EDIFACT, EANCOM, ANSI X12; based on XML-standards, for example ebXML, RosettaNet, UBL, papiNET; proprietary standards) in the whole industrial complex and by the types of economic activity, referred to industrialization; *share of the cost of purchases (sales) of goods / works / services for orders transmitted (received) by the enterprise over the Internet, other global information networks (using websites, automated messaging systems between organizations (EDI-systems))
Third stage. Usage of special software	Special software is a collection of programs used to solve a certain class of problems. Designed for building software and hardware systems based on the user's existing hardware (computers, equipment with CNC (computer numerical control), etc.)
Forth stage. Production of ICT and equipment	This stage is increasingly bringing the industry closer to the status of "digital" and characterizes the sequential process of transition from simple consumption of the results of the sphere of information and communication technologies to their production, large-scale development of Russian market of electronic components and equipment and the formation of import-substitution programs
Fifth stage. Production and usage of robots and indicators (industrial Internet)	This stage implies digitalization in the broadest sense as the process of introducing unique digital transmission systems at the level of primary networks, switching and control facilities that provide the process of transmitting and distributing various streams, data/information in digital form at the level of secondary networks. Application of industrial internet technologies

We consider perspectives of digital transformation in short-term perspective, on the basis of analysis of typical profiles of companies' digital readiness (Figure 2).



1 Business-model and strategy
2 Cooperation with consumers
3 Operations and chains of supplies
4 Supporting functions
5 Digital infrastructure and data
6 Digital cadres and culture
7 Management model of DT (digital technologies)

Source: research "Company Digital Readiness Index" by Strategy Partners

Figure 2. Typical profiles of digital companies' readiness (Strategy.ru, 2020a; Strategy.ru, 2020b)

Business-model and strategy. For leaders, the business model is the driver of DT. For beginners, business model transformation is lagging behind. Special attention should be paid to business model issues in the early stages of DT.

Cooperation with consumers + Operations and chains of supplies. Most companies start DT with operations and / or customer interactions. For leaders, interaction with consumers is the leading area of DT.

Supporting functions. The digitalization of supporting functions has traditionally lagged behind. It is necessary to involve these functions in DT and to include implementation initiatives in roadmaps. Complexity: justifying economic effects.

Digital infrastructure and data. In a digital infrastructure, attention needs to be paid to data handling and the openness of the IT architecture and IT infrastructure.

Digital cadres and culture. The development of digital workforce and culture, as a rule, holds back digital transformations in the later stages of DT.

Management model of DT. In the management model, at the first stages of attention, the use case management system and the KPI (key performance indicators) system require attention.

For digital transition companies accept new strategies and change their organizational structure (Table 2).

Table 2.
Changing of organizational structure in digital transformation.

New structural subdivisions	Functions and cooperation with other subdivisions
CDO – responsible for organization of data - "data service"	Aggregation and analysis of data from the entire company, support for the analytical work of departments. Directly subordinate to the CEO, influences the company's policy in the field of data and digital assets. Interaction with CIO in the development of digital IIoT infrastructure
DevOps – special project groups, combining R and D (research and development work), IT specialist, production and service	Responsible for changes in the company, development of new digital services, product updates, after-sales services and provide accelerated product release. Interact with IT departments, R and D, production department and service and support department
Service of clients; experience management	Responsible for ongoing relations with customers, maximizing the usefulness of the product for each of them. Interaction with departments of marketing, sales and after-sales service
Intelligence operations centers IBM, ABB etc.	Collection, storage, processing and presentation (visualization) of data about objects, technological systems or processes. Storage and support of digital twins, etc. Data source, object condition monitoring system, analytics provider and machine assistants
Chain management and portfolio management	Moving from back-offices to front-offices

The most perspective model of digital transformation is based on the scheme of "nested processes" of digital transformation, when the lying closer to the center process defines the parameters of more "external" processes (Urasova, 2019). In this case the "nuclear process" is promotion of new product on the market: digital products' platform, covering all life cycle of the last and integrating all referred to it ecosystem (Figure 3).

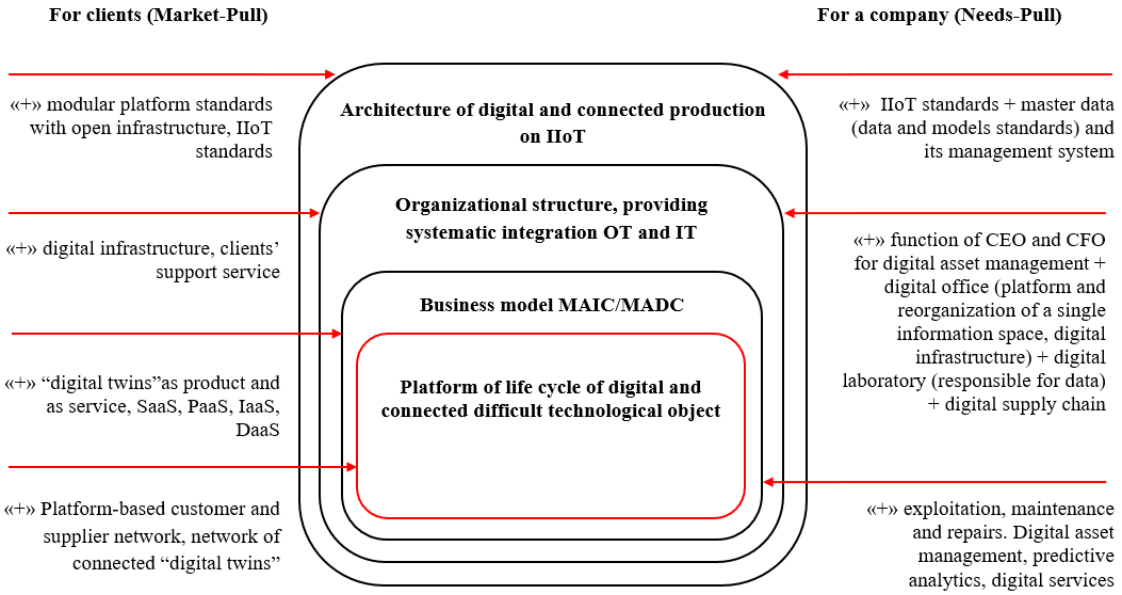


Figure 3. Model of digital transformation on the basis of «Product-driven corporate transformation»

We consider trends of digital companies' transformation, including the ones, working in Russian industrial complex in 2020-2021:

1. Appearance and development of digital platforms in separate spheres (for example in transport, logic and financial accommodation) create new possibilities and threats for business development;
2. Transformation of clients' experience, automatization and the next step to transition to management model on the basis of data and speeding the implementation of DT: big data and smart analytics, robotic process automation (RPA), IoT and II technologies;
3. Speeding of transition to new generation of digital companies' infrastructure: flexible, opened, on the basis of cloud decisions, integration of data (business proposals as infrastructure for digital decisions, practice of and edge-infrastructure);
4. Overcoming the "double challenge" for the personnel policy of companies: acute shortage of employees and competencies for new jobs and automation and the need to reduce traditional ones. Adaptation to new work formats and competency development models;
5. Expanding the possibilities for financing of projects for digital transformation for "consumer" companies and solution providers through government support programs.

In long-term perspective the trends of digital industrial transformation and economics will be:

1. Companies and spheres:

- new business models (payment models: for fact usage, for result, etc.);
- new players and changing industry boundaries (arrival of new players in the industry, who are now considered IT companies);

- increasing the "digital" divide between companies (accelerating the leaders of digital transformation);
- digitalization of small companies (implementation of standard digital decisions, mostly middle and small companies).

2. Trends in society:

- state digitalization (government control will rather grow);
- change in employment (state will have to regulate where to send the released labor as a result of digitalization);
- new system of education (online education);
- work formats' change (deeper and narrower workers' specialization).

Results

The process of economics' digitalization leads to unavoidable change of socially-economical paradigm, society and its different spheres. The appearance of concept "digital economics" is connected to the transition on the new production management stage and the goods' production itself and services on the basis of usage modern informational technologies. Using leading technologies, digital transformation changes the picture of competitiveness, blurs boundaries and changes business models. Bridging the gap in the technological and economic lagging behind the developed countries of the Russian Federation is possible if the following conditions are met:

- increasing the competitiveness of the industry through the implementation and development of breakthrough business models and technologies, such as digital platforms, advanced analytics of big amount of data, 3D printing, robotization, IoT, artificial intelligence, neural networks, blockchain, etc.;
- increasing the transparency of cooperation process with the government, and, as a result, increasing the working climate, which supposes easing the procedures of providing services (registration of a legal entity, obtaining permits, tax declaration, development of a system of digital services for business and online services);
- government finance of educational sphere, cadres preparation, who have DT, creation of re-preparation centers, special programs of adaptation for freed personnel;
- implementation of measures aimed at improving the quality and convenience of receiving services in the field of medicine, culture, education, transport, public and economic security;
- softening the regulatory regime, creating sandboxes (special legal regimes) for pilot projects, developing uniform standards in the field of DT;
- stimulating the interest to digital innovations and development of digital culture, having positive social effect.

Conclusion

Nowadays digital economics becomes one of the main of the main factors, having impact on economic growth and has important consequences for Gross National Product (GNP), production and well-being of households in all sectors of the economy. For successful development of digital economics and reducing the separation with leader-countries Russia has to grow cadre, intellectual and technological advantages, form deep

normative basis for implementing DT in all spheres of the life. The strategy of intensive economics' digitalization and bet on its full transformation, which supposes fundamental re-building government approaches to making decisions, will lead to keeping competitiveness on the global market and reaching positive results.

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Artificial intelligence as a focus of digital economy development: Theoretical and practical aspects

Искусственный интеллект как фокус развития цифровой экономики: теоретические и практические аспекты

La inteligencia artificial como foco del desarrollo de la economía digital: aspectos teóricos y prácticos

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Abstract

The article is devoted to the study of the development of artificial intelligence (AI) technologies and its presentation as the fundamental basis of the digital economy concept, which is implemented within the framework of the Industry 4.0. The purpose of the research carried out in the article is to analyze the areas of effective application of AI methods and tools, as well as to assess the potential for introducing AI into the business sphere. The theoretical and practical aspects of the application of AI technologies in various sectors of the economy are considered. It has been determined that the high cost of introducing technologies and establishing the stages of its functioning is a significant barrier to the use of AI. The data obtained during the course showed that organizations that have invested in identifying, aggregating, standardizing and labeling data will be well placed to combine AI with analytics, IoT and other technologies. It has been found that DevOps techniques can be used to successfully integrate and organize teams, placing development teams and operations teams in a feedback loop for ongoing collaboration and interactive changes to new products. Criteria for assessing the level of maturity of the branches of AI have been determined.

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Keywords: AI, digital economy model, market trends, DevOps methods, industry applications of AI, business process transformation, digital marketing.

Аннотация

Статья посвящена исследованию развития технологий искусственного интеллекта и представления его фундаментальной основой концепции цифровой экономики, реализующей в рамках концепции «Индустрия 4.0». Целью проводимого в статье исследования является анализ областей эффективного применения методов и инструментов искусственного интеллекта, а также оценка потенциала внедрения искусственного интеллекта в бизнес-сферу. Рассмотрены теоретические и практические аспекты применения технологий искусственного интеллекта в различных секторах экономики. Определено, что высокая цена внедрения технологий и налаживания этапов ее функционирования является значимым барьером для использования искусственного интеллекта. Данные полученные в ходе показали, что организации, которые инвестировали в идентификацию, агрегирование, стандартизацию и маркировку данных, будут иметь хорошие возможности для объединения искусственного интеллекта с аналитикой, IoT и другими технологиями. Установлено, что для успешного объединения и организации работы команд могут быть использованы методы DevOps, которые помещают команды разработки и операционные группы в цикл обратной связи для постоянного сотрудничества и интерактивных изменений новых продуктов. Определены критерии оценки уровня зрелости отраслей искусственного интеллекта.

Ключевые слова: искусственный интеллект, цифровая модель экономики, тренды рынка, методы DevOps, отраслевое применение искусственного интеллекта, трансформация бизнес-процессов, цифровой маркетинг.

Resumen

El artículo está dedicado al estudio del desarrollo de tecnologías de inteligencia artificial (IA) y su presentación como base fundamental del concepto de economía digital, que se implementa en el marco de la Industria 4.0. El propósito de la investigación realizada en el artículo es analizar las áreas de aplicación efectiva de los métodos y herramientas de IA, así como evaluar el potencial para introducir la IA en el ámbito empresarial. Se consideran los aspectos teóricos y prácticos de la aplicación de tecnologías de IA en varios sectores de la economía. Se ha determinado que el alto costo de introducir tecnologías y establecer las etapas de su funcionamiento es una barrera importante para el uso de la IA. Los datos obtenidos durante el curso mostraron que las organizaciones que han invertido en identificar, agregar, estandarizar y etiquetar datos estarán bien posicionadas para combinar IA con análisis, IoT y otras tecnologías. Se ha descubierto que las técnicas de DevOps se pueden utilizar para integrar y organizar equipos con éxito, colocando a los equipos de desarrollo y operaciones en un circuito de retroalimentación para la colaboración continua y los cambios interactivos en nuevos productos. Se han determinado criterios para evaluar el nivel de madurez de las ramas de la IA.

Palabras clave: IA, modelo de economía digital, tendencias de mercado, métodos DevOps, aplicaciones industriales de IA, transformación de procesos de negocio, marketing digital.

Introduction

In connection with the digital transformations taking place in modern realities, the emergence and application of new technologies tends to increase. All spheres of business and public life are introduced by smart systems that can operate effectively in a dynamically changing world. The digital economy is the basis of the entire system of government, economy, new business models and basis of the fourth industrial revolution. AI technology has been researched for over half a century. In the course of the development of this field of science, interest in such a promising area of IT field varied depending on scientific achievements and the development of applied areas of AI application. Over the past 10 years, there have been many important advances in improving the components of this technology, and IT market has identified new possible uses for AI. Business entities need to use this tool to maintain competitiveness and develop their subsystems, which prompts states to join the technological race in order to stimulate the economy, strengthen their geopolitical positions and improve the living standards of the population (Dadashev & Ustinova, 2019). This opinion is shared by the leaders of states, as well as the heads of the largest corporations. The purpose of this study is to analyze the areas of effective application of AI methods and tools, as well as to assess the potential for introducing AI into the business sphere.

Literature Review

Currently, AI is a general term that combines many more specific concepts, such as computer vision, neural networks and machine learning. This is the so-called "AI in a narrow sense", which is defined through the description of the use cases of technology, which include the use of large amounts of data for the analysis, modeling and forecasting of events. AI in the broadest sense (strong AI) is a "super machine" that is able to independently develop and make decisions without being guided by the models and sets of rules that are previously provided to it for processing. The term AI as a tracing paper from English does not satisfy the experts: many of them talk about inaccurate translation, which distorts the essence of the technology. Instead, a whole set of terms is proposed: broader - robotic intelligence, inhuman intelligence; or more tool-focused - neural network, (deep) machine learning. In any case, the emphasis is shifting from the human and the analogue of human intelligence. Experts explain the term through tools that work autonomously and not always in the image and likeness of a person. We can even say that it is precisely other forms, different from human thinking that will lead to the success of AI (Sokolova & Galdin, 2018).

Within the framework of the research carried out in the article, the concept of AI is defined in its broadest sense - as a set of technologies for processing various types of data and information, in particular, capable of interpreting such data, extracting knowledge and using it to achieve certain goals. Machine learning, in turn, is defined as a class of AI methods, which are characterized by the performance of specific tasks by computer systems by correlating them with previously performed tasks of a similar type without using explicitly established instructions. AI is already creating additional sources for the

growth of business value. AI leaders are scaling up their investments and devising large-scale strategies for implementation. The assessment of the size of AI market in the Russian Federation varies greatly depending on the research methodology. We consider in more detail the criteria for assessing the level of maturity of AI industries (Table 1).

Table 1.
Criteria for assessing the level of maturity of AI industries.

Rating element	Criterion	Legacy (1 point)	AI Ready (2 points)	AI Native (3 points)
Foundation of AI	Software and architecture. Availability of specialized industry solutions based on AI	Individual solutions	Solutions for 1-10% of industry processes	Solutions for > 10% of the industry's processes
	Data. Data availability and usability for the development of industry solutions	Data is poorly available and mostly not used	Data is available and used for 1-10% of industry processes	Data is available and used for > 10% of industry processes
	Hardware. Percentage of large and midsize companies in the industry using Iaas / PaaS / SaaS cloud services	Mainly on-premise, individual companies use IaaS / PaaS / SaaS elements	Major industry players use onpremise / IaaS as well as PaaS / SaaS elements	Major industry players use PaaS / SaaS as well as IaaS elements
	Regulation. Existence of incentive industry regulation	Has little impact on the industry	Removes major barriers to the use of AI	Stimulates the development of new applications for AI
Industry indicators	Personnel and qualifications. Percentage of d-people from the total number of employees in the industry (from the number of the central office)	<1%	1-10%	>10%
	Popularization. Level of awareness of companies about industry solutions in the field of AI	< 10%	10-50%	>50%
	Investments. Percentage of investment in the development of AI from all investments in the industry, including intracorporate	<1%	1-10%	>10%

According to the results of the research "Current trends in the market of AI and machine learning" at the end of 2017, AI segment in Russia was limited to 700 million rubles. AI market is expected to grow to 28 billion rubles by 2021. According to the forecasts of the authors of the study, its growth will be stimulated by the financial sector, retail trade and industry. According to the results of the research "Digital Economy: Global Trends and Practice of Russian Business" conducted by the Higher School of Economics, digital technologies came out on top in terms of the greatest impact on business: IoT and industrial automation (60%), digital design and modeling (58%), virtualization technologies, remote access, remote office, etc. (57%), mobile technologies and cross-channel communications (55%). Analyzing the data obtained by American and British financial analysts, we can draw obvious conclusions that the rapid development of robotics using AI technologies will lead to another leap in productivity. According to experts, this figure will grow by 30% in the whole world, accompanied by a decrease in labor costs in the range of 20-33%. Naturally, first of all, the so-called “disruptive innovations” will affect the most developed countries, which will lead to a technological reboot of several key industries at once (Mustafina, 2019).

Research Materials and Methods

The research used the methods of quantitative and qualitative expert interviews. In addition, an analysis of the secondary data was carried out. Research experts - Russian and international leaders and leading specialists in the field of AI involved in the implementation of related projects in various segments (industrial production, retail, etc.).

Recently, there has been an impressive leap forward in the development and especially the application of AI based on the use of neural networks. Great results have been obtained in solving problems such as speech, image and face recognition. These technologies are based on a rather crude copying of the work of the human brain and do not always give the expected results. The challenge for science is to understand how AI works. Technologies often start working before our understanding of all the details of their work. Without this understanding, all sorts of incidents inevitably arise. The main problem in AI theory is to understand why neural networks work, despite the fact that, from the point of view of classical mathematics, the task of constructing neural networks is incorrect, because the number of observations (training examples) is several orders of magnitude less than the number of determined parameters, but, nevertheless, in practice, the network works. We do not yet have a theoretical understanding of why the network works. Although it should not stop us to introduce these technologies. The main challenge for scientists is to learn as soon as possible how AI technology works. To raise AI to a new level of development and obtain predictable and reliable results, it is necessary to build a new or significantly modify the existing theory of AI (Efimova, 2020).

Analyzing the potential of AI, researchers began to look for new areas of its application, primarily in conjunction with improving business processes. The use of AI in this area makes it possible to make business processes flexible and adaptive, abandon traditional pipelines and move on to the idea of integrating advanced AI systems and people. This approach allows radically changing the interaction of a machine and a person and forming integrated teams of robots and people. Such teams are able to quickly process large amounts of data during production operations, assimilate new information and adapt

to continuously changing conditions. These AI capabilities allow companies to reengineer their business processes, significantly increase their productivity and reduce costs. Thus, one of the main directions of development and implementation of AI in industry is the reengineering of business processes. Another area is to supplement and expand human capabilities, when machines do what they can best (performing repetitive, monotonous tasks with processing enormous amounts of data), and people do what they do best (working with ambiguous information, inference in difficult cases, decision-making in conditions with a high level of uncertainty, creativity, etc.). This direction is usually called the third wave of business transformation (Kryukova & Mikhalenko, 2017).

Statistics show that in the period 2016-2019 revenues of the world market for AI increased by 350%, from 3221.8 to $ 11283.76 million (Figure 1). By 2025, revenues are expected to rise to $ 89847.26 million.

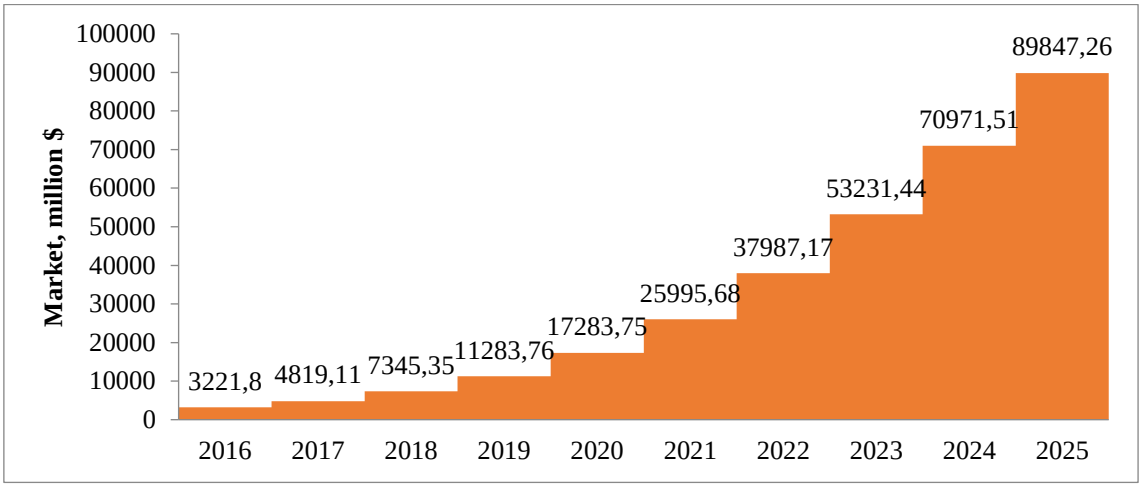

Figure 1. Revenues from the global market of AI from 2016 to 2025, million $

The impact of AI on world GDP is due to increased labor productivity, personalization, reduced time consumption and improved quality of products, works and services. Global labor productivity growth is expected to account for 55% of the cumulative impact of AI on global GDP over 2017-2030. We consider the use of AI in various sectors of the economy (Petrov, 2019).

Marketing and advertising. The introduction of AI in the field of marketing and advertising affects the increase in business profitability, significant improvement in targeting and increase in customer focus. At the same time, these benefits from AI can be used by companies from any sphere: banking, metallurgy, transport. The growing introduction of Big Data technology into the advertising market requires both advertisers and agencies to apply AI technologies to effectively analyze user data in order to obtain accurate knowledge about the audience and customer preferences. At the same time, AI allows not only to obtain complete information about users, but also to predict their behavior in the future. AI in ads is used for targeting. This is typical not only for banks, but for all digital marketing. Banks have information about transactions and this gives an advantage (Trofimov, 2019).

Retail. AI in retail is finding ever more widespread use: it is not only improving communication with customers, but also pricing optimization, working with inventory,

making decisions about the time and format of promotions and sales. According to experts, today any large retail company uses AI. This is due to the amount of data that can be analyzed in real time. In addition, the benefits are immediately noticeable through the use of process automation tools. There are main tools: automatic (smart) cash registers and recommendation services. Stores provide ordering of products based on the analysis of consumer activity. Consumers are offered discounts on goods according to their shopping basket, promotions and special offers are formed.

Banking. This sector of the economy is noted by all experts as the most promising for the development of AI. This can be explained by the fact that banks have a large amount of data that can be analyzed. The use of AI in the banking sector can be divided into two types: solving the internal tasks of the bank as an organization and customer service. To improve efficiency and simplify internal processes, decision-making automation tools and tools that increase the number of decisions are used (for example, various scoring options). Robots are also often used to automate internal processes. They help improve the efficiency of basic routine procedures. Machine intelligence is applicable for scoring, quick decision-making, risk assessment when issuing a loan and when analyzing a borrower's solvency. Scoring is also used to work with clients - these are numerous tools that allow identifying creditworthy citizens, and the formation of individual proposals for deposits and tariffs. Another tool is face recognition technology that can be used to identify customers. The potential of this technology also improves safety.

Telecommunications. Telecommunications companies, like banks, have an extensive database of their subscribers. Therefore, one of the first areas of application of AI in telecommunications was marketing, in particular, solutions for retaining customers and increasing their loyalty. Today, telecommunications companies use chat bots to answer customer questions, predictive analytics to form a tariff grid and calculate the likelihood of subscribers using certain services. Companies use machine learning and behavioral analysis based on machine learning to calculate fraudulent calls. AI allows predicting the load of network resources and optimize their distribution in accordance with forecasts.

Industry. The heavy industry sector has great potential in the implementation of AI, primarily through rapid prototyping or dynamic resource allocation - equipment modification. For manufacturing companies, the main advantage of AI is the reduction in the number of errors in work related to the human factor, reduction in the number of manual work processes and predictive analytics. A joint study by Tsifra and the Russian Union of Industrialists and Entrepreneurs reflects the upward trend in demand for AI technologies from industrialists. According to the study, AI is used in industry to increase the service life of industrial equipment and improve the efficiency of its maintenance is 44%. In the Russian industry, AI technologies are used in production (metallurgy, chemistry, petrochemistry, oil refining and oil production) - 22%, in the electric power industry - 11%. The remaining 23% are research papers from universities exploring the application of AI methods in new areas for the industrial sector. The experts interviewed for this study are also optimistic in their forecasts of the effectiveness of AI implementation in industry and note the advantage of large databases for work that stimulate the development of AI. The data is used to train AI systems, for forecasting and for the development of recommender systems, which are then used to optimize production

and administrative processes. AI helps to work with a large number of factors, analyze the influence of each and draw conclusions.

The most common elements of AI in industry are automated tools and cognitive assistants. Also, digital twins are often used systems that, based on machine learning, help optimize organizational processes. These technologies are gradually replacing workers who perform typical tasks, which in turn lead to cost savings.

The results of various studies carried out in Russia and abroad show a number of common problems faced by organizations implementing AI technologies. Most experts share the opinion that this is a fundamentally new phenomenon that is becoming a challenge not only for a group of professionals, but for the entire society. According to analytical companies SAS and Deloitte, the main difficulties in the development of AI are (Shchurina & Danilov, 2019):

- changing the list of professions and human skills in demand;
- regulatory and legal risks;
- ethical issues.
- international research draws attention to several blocks of barriers to the introduction and use of AI. Pioneer organizations identify among the main barriers to the adoption of AI technologies;
- lack of support from management;
- unclear business case.

The latter challenge was most often mentioned by Russian experts during in-depth interviews. The high cost of introducing technologies and establishing the stages of its functioning is a significant barrier to the use of AI. The economic benefit cannot always be demonstrated in the short term, which may be the reason for the closure of individual projects. AI has a more promising development when interacting with other technologies that are gaining popularity in 2019. Successful AI integration with other technologies starts with data. Organizations that have invested in identifying, aggregating, standardizing, and labeling data will be well positioned to combine AI with analytics, IoT and other technologies. To successfully connect and organize teams, DevOps techniques can be used, which put development teams and operations teams in a feedback loop for ongoing collaboration and interactive changes to new products. At the same time, it is necessary to create new roles for employees as translators and links between different groups. Models also need regular testing, updating and replacement (Ilin et al., 2017).

DevOps enables software deployments that are stable, fast and reliable, including through continuous testing, to avoid the delays and quality issues inherent in the classic design model. DevOps culture can evolve in companies either in an evolutionary way, when employees understand that processes are emerging that can be automated or in order to achieve new business goals. When a company needs to put new processes on track, it always needs specialists who can implement and develop the right tools. There are several benefits to the business moving to DevOps:

- faster time to market (faster cycle times and faster deployment);
- improved quality (increased availability, fewer disruptions, etc.);

- increase in organizational efficiency (more time is spent on activities associated with an increase in the value of the product in comparison with losses or in the amount of functionality transferred to the customer).

Results

Today in Russia, as in the whole world, interest in AI is huge: leading countries of the world are developing strategies for the development of AI, technology is discussed at all possible levels, from scientific conferences to social networks. At the same time, there is currently no generally accepted understanding and unified definition of what AI is. As a result, the attitude to technology on the part of society and industry is still ambiguous: questions remain regarding the safety of using technology, its impact on social well-being and human rights (in particular, right to privacy). Business and government agencies in Russia have already come to understand the benefits that the introduction of AI technology brings, but most business representatives do not yet fully understand how exactly the technology should be applied in order to achieve the results they need. The situation is gradually changing with the start of discussion of this topic at the highest government levels, as well as with the emergence of various successful cases of using AI.

Technology development leaders are USA, China, Japan. The participants in this study rank Russia among the countries with a high potential for the introduction of AI. The main types of application of AI technology in Russia, identified in the course of the study, generally coincide with global trends. In Russian companies, these are:

- agents (automated support services for banks, medical and telecommunications institutions, chat bots of client services);
- algorithms that optimize decision-making process are used in all areas: from industry (recommendation systems for making technological decisions, improving production safety) to retail (logistics tasks, studying customer behavior) and banks (forming individual proposals, improving targeting);
- automation of production processes in companies with a wide profile, "smart" devices (image recognition systems).

Conclusions

According to experts, the leaders in the implementation and use of AI in the Russian market are industrial enterprises, banks, telecommunications companies and retail. Industrial enterprises are actively introducing tools for automating internal and production processes. Recommender services are used at all stages of the production process for monitoring current processes and for predicting future events. The banking industry uses various scoring tools to automate routine functions, streamline and speed up decision-making processes. Banks use the accumulated knowledge about their customers and develop recommendation services on this basis. For identification and security purposes, image recognition technologies (biometrics, face recognition) are used. Telecommunications companies use chat bots to answer customer questions, predictive analytics to form a tariff grid and calculate the likelihood of subscribers using certain services. Companies use machine learning and behavioral analysis based on machine learning to calculate fraudulent calls. AI allows predicting the load of network resources and optimize their distribution in accordance with forecasts.

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