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О. Экономическое развитие, инновации, технологические изменения и рост
O. Economic Development, Innovation, Technological Change, and Growth

УГЛУБЛЕНИЕ ВЗАИМОДЕЙСТВИЯ ПРОМЫШЛЕННЫХ И НАУЧНЫХ ОРГАНИЗАЦИЙ РЕСПУБЛИКИ БЕЛАРУСЬ В КОНТЕКСТЕ НАЦИОНАЛЬНЫХ И ГЛОБАЛЬНЫХ ВЕКТОРОВ РАЗВИТИЯ

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Аннотация. На основе изучения мировых тенденций оценивается состояние промышленного комплекса и научных организаций Республики Беларусь, а также раскрываются перспективы их развития. Предлагается проводить такую оценку с опорой на разработанную методику, включающую ряд обязательных этапов: анализ современного состояния, выявление направлений сотрудничества, оценку ресурсов и потенциала, изучение законодательства и условий ведения бизнеса, оценку возможностей и выгод, разработку стратегии, налаживание контактов и общения. Представляется обзор состояния мировой промышленности, определяются глобальные и национальные тренды развития, делается акцент на возникающих затруднениях при достижении предприятиями промышленности устойчивого роста. Изучается зарубежный опыт развития предприятий в условиях становления индустрии 4.0, выявляются ключевые драйверы, способствующие их устойчивому росту и направленные на выстраивание адаптационных бизнес-процессов в современных условиях ведения хозяйственной деятельности. Рассматриваются параметры функционирования научных и производственных организаций. Определяются условия для трансформации бизнес-процессов, приводящих к укреплению позиций предприятий промышленности на мировом рынке, с учетом таких векторов развития, как процессы сетизации, цифровизации, инновативности и сервисизации, соответствующих предложенной к рассмотрению концепции бизнес-экосистем. Применяемые методы исследования включают системный подход и частные методы (синтез, анализ, моделирование и прогнозирование).

Ключевые слова: промышленный комплекс; научные организации; тренды; оценка состояния.

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DEEPENING THE INTERACTION BETWEEN INDUSTRIAL AND SCIENTIFIC ORGANISATIONS OF THE REPUBLIC OF BELARUS IN THE CONTEXT OF NATIONAL AND GLOBAL DEVELOPMENT VECTORS

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Abstract. The article aims to assume the state of Belarus industrial complex and scientific organisations and release prospects based on global trends. The research proposes to carry out such an assessment based on the authors' developed methodology, which includes several mandatory stages: analysis of the current state, identification of cooperation areas, assessment of resources and potential, studying legislation and business conditions, assessing opportunities and benefits, strategy development, establishing contacts and communication. The article presents a global overview of the state of industry, identifies global and national development trends, and focuses on the emerging difficulties in achieving sustainable growth by industrial enterprises. The foreign experience in the development of enterprises in the context of the formation of industry 4.0 has been studied, and the key drivers that contribute to their sustainable growth, aimed at building adaptive business processes in modern conditions of economic activity, have been identified. The parameters of the functioning of scientific and industrial organisations are analysed. The conditions for the transformation of business processes leading to the strengthening of the position of industrial enterprises in the world market are determined, considering such vectors of development as the processes of networking, digitalisation, innovation, and serviceisation, corresponding to the concept of business ecosystems proposed for consideration as strengthening the business potential of enterprises and their further interaction. The applied research methods include a systematic approach and such private methods as synthesis, analysis, modeling, and forecasting.

Keywords: industrial complex; scientific organisations; trends; state assessment.

Introduction

There is an acute problem of developing scientific approaches to studying and managing the industrial organisation's innovative development. The existing interaction conditions between state bodies, and industrial and scientific organisations are not always based on scientific approaches and meet the economic feasibility requirement in an unstable external environment. As a result, this leads to poorly predictable consequences that do not meet the goals of innovative development.

Current trends in the innovative development of Belarus are characterised by a relatively low level of innovation activity, a break in previously created value chains of innovative goods (an urgent need to create new chains), unfavourable external conditions for the export of innovative products (the need to reorient areas of interaction), etc. General globalisation, which involves supranational mechanisms for regulating innovative development, has exhausted itself.

The world's medium- and low-tech industries are constantly adapting to the changing conditions of the business environment. It should be noted that the growth of industrial goods markets has been significantly slowed and limited by the effects of the COVID-19 pandemic. According to the UN Industrial development report 2022, the observed decline in production in the period of 2020–2021 has outlined the recovery of the manufacturing sector as the main goal for the world community at the global level[1]. The effects of the crisis have harmed the resilience of industrial enterprises to a greater extent in developing countries, countries with economies in transition, and the least developed countries by reducing the production of goods critical to society's sustainability due to disruptions in the supply of raw materials. Despite the adverse effects of the pandemic, the global market for manufactured goods is recovering due to increasing factors stimulating consumer demand, new technological advances, and a shift in the focus of the global economy towards achieving the sustainable development goals. Therefore, in our opinion, it is relevant to identify the key drivers for the development of medium- and low-tech industries, which make it possible to neutralise the impact of crisis phenomena on the economic activity of enterprises in the current conditions of the formation of industry 4.0.

In modern economic conditions, it is necessary to construct new forms, principles, and conditions of interaction between state bodies and scientific and industrial organisations for innovative development and to ensure the country's economic security and its stable economic growth.

[1]Industrial development report 2022. The future of industrialization in a post-pandemic world // UNIDO : portal. URL: https://www.unido.org/idr2022 (date of access: 30.10.2023).

Some scientific publications are devoted to assessing the state of industrial complexes and scientific organisations. Scientists conducted studies on the issues of assessment of the effectiveness of the industrial and scientific institutions activities [1], development of industrial complexes [2], regional typology according to the level of development of industrial complexes [3], and global innovation efficiency assessment [4]. A distinctive feature of the publication is that the study is based on an analysis of the state of scientific and innovative activities in Belarus, the potential of the human resources of researchers, and, based on the study of foreign experience. Recommendations for Belarus are given.

There are many theoretical and conceptual approaches to assessing the state of industrial complexes and scientific organisations. Such an assessment can be made based on the development of various theories and conceptual approaches. Here are the main ones.

According to the production efficiency evaluation model [5; 6], the organisation can evaluate and optimise the production process. This includes assessing different aspects of production operations to identify inefficiencies, bottlenecks, and areas for improvement. The goal is to increase productivity, reduce waste and ultimately increase the overall efficiency of the production process. By implementing a production efficiency assessment model, organisations can strengthen their manufacturing processes, reduce costs, improve product quality, and stay agile in response to changing market demands.

Economics is a multifaceted field in which individuals, businesses and governments consider how to make choices and allocate resources to meet different goals and needs [4; 7]. Various economic theories and models provide insight into balancing competing interests in different economic contexts. For example, cost-benefit analysis is a technique used to assess the cost-benefit balance of a particular decision or policy. This helps decision-makers weigh trade-offs and make choices that maximise overall welfare.

Another approach that seems useful for key elements search is achieving sustainable growth. For that reason, we need to turn to the concept of business ecosystems, which was developed in the late 1990s in the works of Western scientists [8–10], etc. Later, that approach was developed when it was needed to consider the influence of such phenomena as networkisation, digitalisation, innovation, and serviceisation, which determine the modern vectors of transformation of traditional industries.

The innovation system approach focuses on the interaction and interdependence of various actors, including government, industry, and science, in promoting innovation and economic development [11]. This underscores the importance of networks, institutions, and policies in shaping the innovation ecosystem.

Materials and methods

As part of the study, it is essential to determine which indicators will be considered when analysing the state of industrial and scientific organisations. Standard methods of scientific knowledge, such as observation and description, modeling, and statistical data analysis, were used. Such indicators as the international network readiness index, the global innovation index, and the world digital competitiveness index were analysed, which served as indicators for assessing the readiness of countries to transform the business models of industrial enterprises based on the principles of the ecosystem approach.

The article proposes to carry out such an assessment based on the author's developed methodology, which includes several mandatory stages: analysis of the current state, identification of areas of cooperation, assessment of resources and potential, studying legislation and business conditions, assessing opportunities and benefits, strategy development, establishing contacts and communication, risk assessment.

The strategy development for Belarus should be based on a comprehensive and well-balanced approach that considers various aspects of the country's socio-economic, political, and cultural context. The strategy development process needs to be input from multiple stakeholders, including government officials, experts, civil society, and international organisations. The strategy should be flexible and adaptive, allowing for adjustments in response to changing circumstances.

Additionally, clear communication and transparency about the strategy's goals, progress, and outcomes are essential to garner support and build stakeholder trust. Belarus already has a foundation through its diplomatic missions, international memberships, and participation in global events. However, proactive efforts, resource allocation, and a strategic approach are essential to maximise the benefits of these existing contacts and establish new ones to support the country's development goals.

Results and discussion

The current state analysis is proposed to be done based on observation of the data on scientific and innovative activities in Belarus (table 1). To assume the opportunities and benefits of Republic of Belarus, it needed to summarise data in tables 1–3 and consider additional information about the state of the country.

We discovered that indexes listed in table 1 might be used to describe the state of industrial innovation enterprises and the potential for developing scientific and industrial complexes.

Table 1

Dynamic of indexes characterising scientific and industrial complexes in Belarus

Index	Year							
	2015	2016	2017	2018	2019	2020	2021	2022
Number of organisations that spent on innovation	415	409	416	466	501	528	521	521
Share of organisations that spent on innovations in the total number of surveyed organisations, %	21.0	21.1	21.6	22.0	21.1	20.6	19.7	20.0
Share of shipped innovative products (works, services) in the total volume of shipped products (works, services) of industrial organisations, %	13.1	16.3	17.4	18.6	16.6	17.9	19.8	17.7
Number of R&D organisations	439	431	454	455	460	451	445	448
Number of employees engaged in research and development	26 153	25 942	26 483	27 411	27 735	25 622	25 644	25 233

Note. Developed on the basis of the Republic of Belarus official statistics.

Identifying cooperation areas is to be based on analysing Belarus' position in various rating systems (table 2). Belarus has not been presented since 2020 in some of the main international ranking systems, assuming the state of the scientific and industrial innovation development on the country level. We decided to conduct the analysis over the last accessible period (2018–2020) as that number of years is enough to come to some conclusions.

Table 2

Belarus' position in the leading international rankings of scientific, technical and innovative development

Ranking system (database)	Year		
	2018	2019	2020
Human development index	53 out of 189 countries	50 out of 189 countries	53 out of 189 countries
Doing business ranking	37 out of 190 countries	49 out of 190 countries	49 out of 190 countries
Industrial competitiveness index	47 out of 150 countries	46 out of 150 countries	47 out of 152 countries
Global innovation index	86 out of 126 countries	72 out of 129 countries	64 out of 131 countries
Science and technology index of the good countries index	28 out of 153 countries	28 out of 153 countries	23 out of 149 countries

Note. Developed by the authors on the basis of the Republic of Belarus official statistics.

These rankings suggest that Belarus has made some progress in innovation and competitiveness. However, we should pay more attention to the questions of innovation and the industrial environment. This has helped the country to remain competitive in industries such as mechanical engineering and electronics, where accuracy and technical expertise are essential.

The problem of achieving sustainability in modern industries requires significant changes in the methods of production and consumption of goods, giving them new properties that are relevant to society, which the efforts of only one enterprise cannot solve. There is a need for a comprehensive renewal of medium- and low-tech industries by transforming the forms of inter-organisational interaction not only within the industry but also outside it. Such a comprehensive solution for transforming enterprises' business models to achieve sustainable growth, in our opinion, can be the application of an ecosystem approach to the management of industrial enterprises. The ecosystem approach does not allow the study of an enterprise or industry as an isolated unit. Still, it is an integrated strategy that assesses the possibilities of participation of economic agents in a complex network of interaction with other organisations, industries, and public and state institutions acting as suppliers, intermediaries, or customers, based on principles like the principles of the development of biological ecosystems.

We decided to assume the potential for development based on an analysis of the educational institutions (table 3).

Table 3

Dynamic of educational institutions as well as workers and students

Indicator	Year	Vocational education and training institutions	Institutions of secondary special education	First stage of higher education
Number of educational institutions	2015	206	231	52
	2016	196	230	51
	2017	182	226	51
	2018	180	226	51
	2019	176	224	51
	2020	176	223	50
	2021	172	221	50
	2022	170	221	50
Number of graduates of educational institutions	2015	31 090	39 017	77 973
	2016	31 249	36 335	74 571
	2017	30 593	36 413	80 956
	2018	28 975	33 809	64 892
	2019	28 013	33 212	57 452
	2020	25 551	33 352	54 637
	2021	23 855	33 310	55 405
	2022	22 612	30 112	57 095
Number of teaching staff	2015	8883	9802	21 993
	2016	8452	9902	21 623
	2017	762	9743	20 871
	2018	7337	9554	20 256
	2019	7042	9608	19 943
	2020	7049	9573	19 671
	2021	6783	9307	19 075
	2022	6491	9263	18 121

Note. Developed on the basis of the Republic of Belarus official statistics.

In the authors' opinion, the justification of modern trends in the development of industrial enterprises should be carried out on the examples of various countries of the world, in particular those belonging to the group of developed countries, which entirely use their financial, managerial, and technological potential to achieve sustainable growth.

Establishing contacts and communication for Belarus domestically and internationally is crucial for economic development, diplomacy, and collaboration in various sectors. Belarus is a member of several international organisations, such as the Commonwealth of Independent States and the Eurasian Economic Union. It can leverage these memberships to engage in regional and global dialogues. Collaboration between Belarusian universities, research institutions, and foreign counterparts can promote academic exchanges and research partnerships.

Comparing Belarus to other countries in the industrial and scientific sphere requires considering multiple factors and indicators. The Russian Federation has a larger economy, a more extensive industrial base, and a more robust scientific community than Belarus. It invests significantly in research and development and has a well-established space programme, among other strengths. Poland has a more extensive and more diverse economy than Belarus. It has developed a robust manufacturing sector, particularly in the automotive, electronics, and machinery industries.

Regarding scientific research, Poland has well-established universities and research institutions and is actively involved in EU-funded research projects.

One of the key factors in Germany's industrial success is its emphasis on research and development. The country has a strong tradition of investing in scientific research and technological advancements, which allows German industry to remain at the forefront of innovation. This focus on research and development has led to

the development cutting-edge technologies and products, giving German companies a competitive advantage in the global market. Considering the best practices of achievements in the development of industry in the EU countries in the example of Germany and the country's high rating in the framework of international development indices (table 4), it is possible to graphically present a reference model comparing the readiness of traditional industries (in particular, light industry) of developed, developing countries and countries with economies in transition to transform their business models under the influence of such processes as serviceisation, digitalisation, innovation and networking.

Table 4

Germany's position in the international ranking of innovation, network, and digital development as of 2022

Indicator name	Network readiness index	Global innovation index	Digital competitiveness index
Meaning (from 0 to 100)	76.11	57.20	85.17
Position in the ranking among countries	8 out of 131 countries	8 out of 128 countries	19 out of 63 countries

Note. Developed on the basis of the data from global innovation index, network readiness index 2022 and the international yearbook of industrial statistics.

Another critical aspect of the German industrial complex is the close cooperation between academia, industry, and government. The close relationship between these sectors has fostered a culture of knowledge sharing, innovation, and continuous improvement. Universities and research institutes work closely with industrial partners to develop new technologies, and government policies support and stimulate industrial growth. A highly skilled workforce also characterises Germany's industrial complex. The country has a well-established system of vocational education and training that ensures that workers have the necessary skills and experience to meet the needs of the industry. This focus on skill development has helped the German industry maintain high productivity and produce high-quality products.

Conclusions

Belarus has strengths in specific sectors, such as machinery and electronics manufacturing, and benefits from its strategic location and partnerships in the region. However, it faces challenges, including political factors, to compete globally. To further enhance its industrial and scientific capabilities, the country may consider diversifying its economy, strengthening innovation, fostering entrepreneurship, and engaging in international collaborations and partnerships. Belarus occupies a unique position in the industrial and scientific sphere among its peers in Eastern Europe and beyond.

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