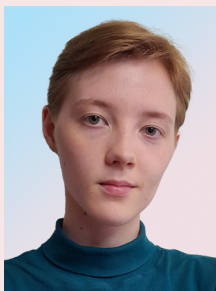


Modernization of the Industrial System through Digital Intelligent Transformation and Green Development: Experience of Russia and China



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Abstract. In Russia and China, a course has been outlined to accelerate the transformation of traditional and stimulate the development of strategically important sectors of the economy in order to build a modernized industrial system. The aim of the study is to explore the possibilities of modernizing regional

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industrial systems in the Vologda Region and Jiangxi Province from the perspective of digital transformation and green development. To achieve this goal, tasks such as analyzing the state of the regional industrial systems of the designated regions, studying the directions of their modernization, and proposing measures to facilitate this process were solved. In traditional sectors of the economy, the processes of transformation and integration of the real and digital sectors of the economy are accelerating. At the same time, the promotion of the synergy of digital intellectual transformation and green growth is hindered by the weak competitiveness of industries concentrated in the middle and lower links of regional value chains, the lack of necessary technologies, and uncertainty in value chains. In order to overcome these obstacles, it is important to form industrial clusters in promising sectors of the economy, focus on the development of traditional industries, encourage enterprises to use scientific and technological achievements in production, introduce digital platforms, and apply a number of measures aimed at accelerating the integration of the real and digital sectors of the economy. The novelty of the conducted research lies in identifying trends in digital intellectual transformation and green development of regional industries, as well as in forming a set of measures that contribute to the activation of these processes. The information base of the study was made up of data from the Federal State Statistics Service and the National Bureau of Statistics of China, as well as foreign and domestic research in the field of industrial system modernization. The results of the study can be used by regional authorities in the development of strategic documents to substantiate the directions of economic policy.

Key words: industrial system modernization, digital intelligent transformation, green development, Vologda Region, Jiangxi Province.

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Introduction

The global economy is currently undergoing a number of transformational processes involving changes in international political relations, the emergence of new centers of economic influence, the transformation of market conditions, etc. The spread of technologies and digitalization of production leading to the formation of new sectors of the economy are rather significant trends. Under these conditions, states need to diversify and complicate their economies and strive to achieve technological sovereignty for remaining included in the global space.

Russia and China share a similar vision of the development directions of the countries as a whole and in their individual regions. Chinese President Xi Jinping made an inspection visit to Jiangxi

Province in October 2023, during which he emphasized that the province needs to define its position, chart a course, and integrate resources to achieve targeted progress¹. The meeting with the region's leadership and assets called for accelerating the transformation and upgrading of traditional industries and encouraging the development of new strategic industries to build a modernized industrial system that demonstrates Jiangxi's competitive advantages.

¹ The Chinese President called for the economic transformation of Jiangxi Province while preserving ecology and cultural heritage. Available at: <https://rg.ru/2023/10/13/predsedatel-knr-prizval-k-ekonomicheskoi-transformacii-provincii-zhansi-pri-sohranении-ekologii-i-kulturnogo-nasledia.html> (accessed: 25.02.2025).

Russia has also set a course for modernization of traditional industries and support of strategically important industries. The national development goals of the Russian Federation include the achievement of technological leadership², and a corresponding strategy has been developed to ensure scientific and technological development³. Due to the sanctions restrictions, the country is developing a policy of import substitution, the purpose of which is to reduce technological dependence on other, primarily unfriendly countries (Lenchuk, 2020). In the long-term sanctions pressure, the transformation of the economy should be based on the concept of innovative development (Shirov et al., 2024).

The development of economic sectors and the introduction of sustainable development principles in them in accordance with global trends requires the formation of an industrial system that can ensure the production of high-quality products that meet international standards, as well as the operation of production that ensures the preservation of the environment. The key to its construction is the fusion of real and digital economy with close interaction of digital intellectual transformation and green development, using comparative advantages as opportunities for transition to a qualitatively new level.

In this regard, the aim of the research is to study the possibilities of modernization of the regional industrial system of Russia and China on the example of Jiangxi Province and the Vologda Region from the position of their digital transformation and green development. Achieving the goal requires the fulfillment of the following tasks:

- to analyze the state of regional industrial systems;

- to study the directions of their modernization;

- to propose measures for promoting the modernization of regional industrial systems.

Theoretical background of the study

Industry is the key sphere of material production, making a significant contribution to the gross domestic product (GDP) of most countries in the world. It occupies a central position in the structure of the economy, other sectors function around it, and links between types of economic activity are strengthened. Ensuring the growth of the share of production services in the real economy is due to the technological development of industry, the growth of labor productivity of enterprises (Akberdina, Romanova, 2021).

The scientific community pays much attention to the issues of sustainable development, including at the enterprise level (Galimulina et al., 2023; Tolstykh et al., 2023; Bugryshev, Panikarova, 2024). The functioning of the economy within the paradigm of sustainable development is possible in the transition to an innovative model of the economy, which is especially important in the conditions of exhaustion of extensive sources of growth. It is worth noting that in this context, scientists take a broad view of innovation; this concept includes, in addition to changes in production technologies, a change in economic relations, institutional factors, etc. (Brink et al., 2010).

The scientific community studies the problems of regional and national industrial systems, among them are the opportunities and ways of its modernization. Some researchers define modernization as a complex process, the purpose of which is the formation of an industrial base with technical equipment and industry structure that meet world standards (Porfiriev et al., 2017), while others reduce its essence to the achievement of progressive shifts in economic development (Shi et al., 2023). Modernization implies purposeful,

² Presidential Decree 145, dated February 28, 2024 “On the strategy for scientific and technological development of the Russian Federation”.

³ Presidential Decree “On the national development goals of the Russian Federation for the period up to 2030 and in the perspective up to 2036”.

irreversible qualitative changes in the economic system, provided through the introduction of new technologies, the full use of the country's intellectual potential. The objectives of economic modernization are mainly to improve the competitiveness of production systems and the country as a whole. Without reducing the essence of modernization of the economic system to the technical and technological changes occurring in it, we still identify them as one of the key factors that condition this process.

The governments of both countries, Russia and China, are setting a modernization course of development, which implements not only economic but also social policy in line with the innovative development of society. The priority of state support is given to high-tech industries, and the goal of innovation activity is to increase the technological level of production (Shirov et al., 2024).

The transformation of industry in Russia is actively supported by the state, as indicated by a number of adopted strategic documents and regulations. The industrial policy pursued by the state, the foundations of which are laid down in the Federal Law "On industrial policy in the Russian Federation"⁴, aims to form a high-tech, competitive industry capable of ensuring the transition of the country's economy from the raw materials export type of development to the innovative one. The fulfillment of the designated goal requires the wide implementation of digital technologies in all spheres of industrial enterprise activities (Lapidus et al., 2019). In addition, the need for technological re-equipment of enterprises, high-tech development, and knowledge-intensive industries is emphasized (Shirokova, Leonidova, 2022).

A similar vision is evident in the economic policy pursued by the Chinese government. The development of science and technology has been one of the country's top national priorities for the

past two decades⁵. For instance, the 14th Five-Year Plan of China's socio-economic development has set the goal of achieving world leadership in innovation by 2035, which indicates the priority of science and technology initiatives. The key policy directions are the development of the intellectual property sphere, increase in financing of R&D expenditures, and increase in the market capacity of the digital economy.

Air pollution control plays an important role in China's industrial modernization policy. In 2017, only 29.3% of China's 338 major cities met the air quality standards set by China's Ministry of Ecology and Environmental Protection. Accordingly, China's State Council has taken a series of measures to control air pollution, such as issuing and implementing the "Action Plan for Air Pollution Prevention and Control" in 2013 and the "Three-Year Action Plan for Winning the War for Blue Sky Defense" in 2017. Enterprises are the largest source of emissions, and as such, the government has undertaken a number of measures to encourage the development of green industry in the country. These include optimizing the structure of the manufacturing sector, transforming the energy sector with the setting of quantitative targets (Zhang et al., 2021).

Green transition, green innovation and carbon neutrality are being actively discussed among researchers (Jie, Jiahui, 2023; Li et al., 2024), which is particularly important for China, whose energy mix is dominated by coal fuel and other combustible carbon, which negatively affects the environmental situation in many communities. Transportation that does not leave a carbon footprint is being developed to make the green transition. In this regard, the demand for lithium batteries is growing, which is especially important for Jiangxi Province, one of the leading regions in China in terms of reserves of this type of raw material (Ma Hui et al., 2025; Abdulkadyrov, Idrisov, 2022).

⁴ Federal Law 488-FZ "On Industrial Policy in the Russian Federation", dated December 31, 2014.

⁵ China's science and technology policy: Toward global leadership. Available at: <https://issek.hse.ru/news/688845347.html> (accessed: March 9, 2025).

Methods and methodology of the research

The object of the study is the regional industrial system; the subject is modernization of regional industrial systems in the Vologda Region and Jiangxi Province. The selection of these regions is based on their similar industrial structure, with a predominance of manufacturing industries and the key role of metallurgical and chemical production. Furthermore, the regions cooperate in economic and socio-cultural spheres and have similar strategic development goals.

This study focuses on the promising industries of regions (provinces and regions). In Jiangxi Province, these are the strategically developing industries that are grouped into the “*1+2+N*” gradient development model. It includes the priority industries most important for the regional economy, selected on the basis of their profitability.

The top “*1*” is electronic information manufacturing, with gross revenue exceeding one trillion yuan. The sub-sectors include the production of electronic devices and components, intelligent terminals, etc. Achieving this magnitude of performance has allowed Jiangxi to rank first among the provinces in central China and fourth in the country as a whole. The “*2*” place is occupied by the new energy equipment industry, in which a new model of rapid development is being established. In 2022, the industry’s revenue amounted to about 720 billion yuan. Part “*N*” includes potential industries where new advantages of advanced manufacturing are cultivated, including aviation, the Internet of Things, and virtual reality.

Promising economic specializations of the Vologda Region were identified according to the methodology developed by the team of authors from VolRC RAS and Vologda State University (VSU) (Rumyantsev et al., 2022). It is based on an integral assessment of the potential of specialization, made up of a number of components: its effectiveness, market potential, innovation activity and the availability of scientific publications on this type of

activity. Based on this methodology, the following branches of specialization are considered as promising: production of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms; production of cast iron, steel and ferroalloys; production of other steel products by primary processing; sawing and planing of wood; production of rubber products; production of pulp, wood pulp, paper and cardboard.; production of machine tools, machinery and equipment for processing metals and other hard materials (Rumyantsev, 2023).

The information base of the study includes data from the Federal State Statistics Service and the National Bureau of Statistics of China, as well as Russian and foreign studies.

Current interplay of digital intelligent transformation and green development in sectors of specialization

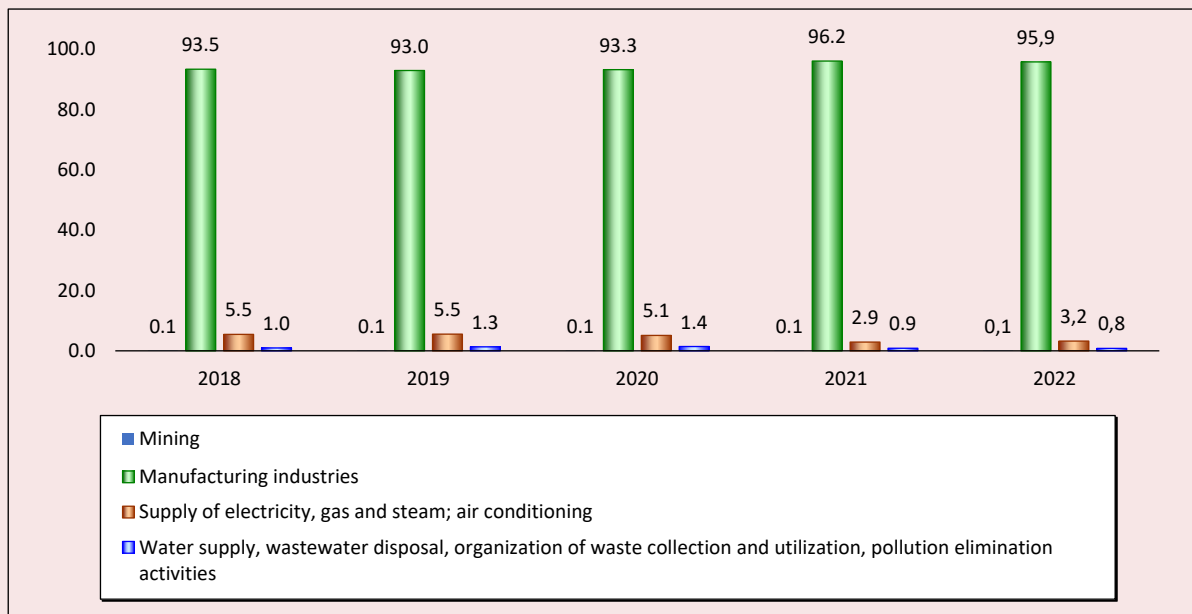
Industrial production prevails in the economic structure of both regions under consideration. The Vologda Region is a representative of Russia’s old-industrial regions (Mel’nikov, 2019). The largest share in the total production volume is occupied by manufacturing industries (*Fig. 1*), based on the technologies of the third technological paradigm.

In 2022, the production of industrial products in the Vologda Region decreased by 3.4%, which is associated with the sanction restrictions imposed on trade with Western countries, the former main buyers of products of this category, primarily metallurgical and wood products (Shirokova, Lukin, 2023).

In the economy of Jiangxi Province, industry is also of great importance. By embarking on industrialization, Jiangxi has increased the share of the secondary sector from 35.0% in 2000 to 44.5% in 2021, putting it in second place after the service sector, which had a share of 47.6% in the same year⁶.

⁶ Jiangxi: Market Profile. Available at: <https://research.hktdc.com/en/data-and-profiles/mcpc/provinces/jiangxi> (accessed: 08.03.2025).

Figure 1. Dynamics of the Vologda Region's industrial production structure in 2018–2022, %



Source: own compilation based on Rosstat data.

The industrial sector is characterized by a complex structure and a high degree of diversification – 38 out of 41 major industries are represented in the province, but non-ferrous metallurgy, namely lithium smelting and processing, and electronic products are the most important for the regional economy⁷. Jiangxi leads China in a number of indicators, with value-added growth rate, industry revenue and total profit ranking 7th, 11th and 10th respectively in 2022.

Traditional industries have comparative advantages, efforts to modernize and improve industrial chains are accelerating. Industrial transformation processes are observed in traditional economic sectors. The acceleration of transformations observed in recent years is associated with the introduction of new production processes, technologies and equipment, and the use of innovative

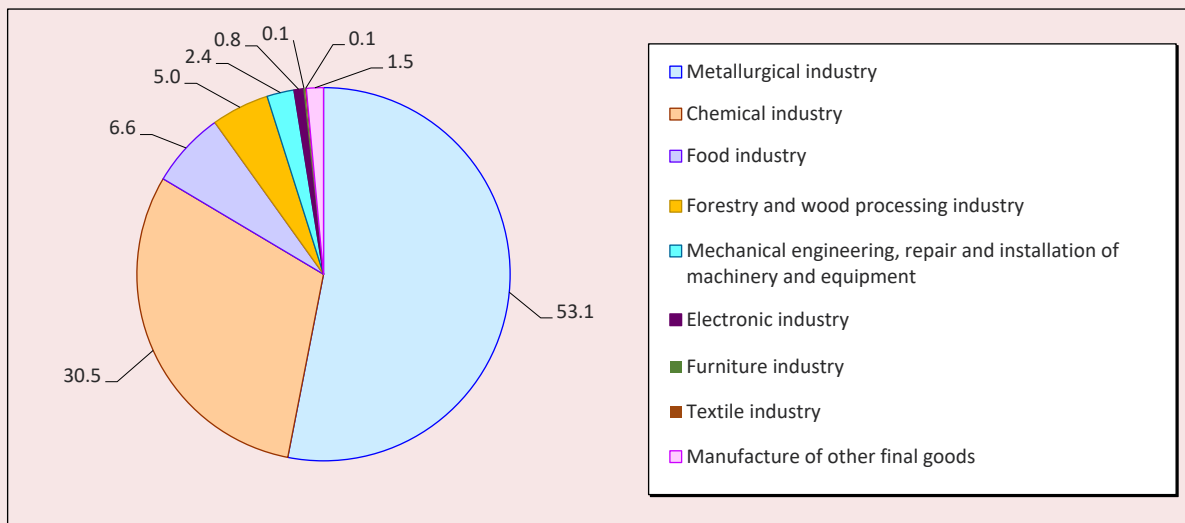
materials. This stimulates industries toward high-tech, intelligent, environmentally friendly, service-oriented production.

The metallurgical complex plays a dominant role in the production sector of the Vologda Region. It accounted for 53.1% of the total volume of shipped goods of the region in 2022. It is followed by the chemical complex. The traditional industries of the region are called the two designated complexes, as well as forestry and woodworking industry (Uskova et al., 2013) (Fig. 2).

The volume of shipments of the **metallurgical complex** amounted to 644.2 billion rubles in 2022. High- and medium-high-tech industries account for only about 15% of all products shipped, which is more than 25% below the national average, and their share has only decreased over the last five years (Bents, Rezepin, 2023). The **chemical complex** industries supplied products worth 343.8 billion rubles (Bents, Rezepin, 2023). The **forestry complex** is characterized by a smaller volume of supplies, only 60.7 billion rubles.

⁷ Jiangxi Province: PRC non-ferrous metallurgy, electronics center. Available at: <https://chinaved.com/provinciya-czyansi-centr-cvetnoy-metallurgii-i-elektroniki-kr> (accessed: 08.03.2025).

Figure 2. Structure of the Vologda Region manufacturing industry in 2022, %

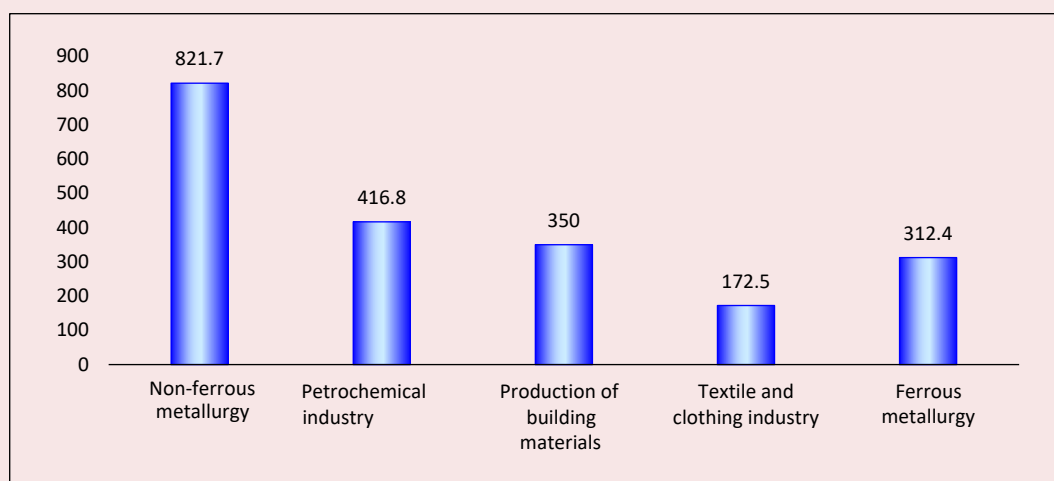


Source: own compilation based on Rosstat data.

In 2022, the volume of supplies decreased compared to the previous year, which is associated with sanctions restrictions on trade with European countries and the United States, which were the main buyers of products of export-oriented complexes. The ban affected the import of goods

used in timber harvesting and processing, which led to difficulties in material and technical support of production facilities. This actualizes the need to develop import substitution and achieve technological sovereignty not only in the forest complex, but also in the industry

Figure 3. Revenue of major traditional industries in Jiangxi Province in 2022, billion yuan



Source: own compilation based on the data from the National Bureau of Statistics of China.

as a whole (Uskova et al., 2022). In Jiangxi Province, the largest traditional industries are grouped into five complexes, among which non-ferrous metallurgy takes center stage. In 2022, it generated 821.7 billion yuan of revenue from enterprises above the set size⁸ (Fig. 3). Total profits amounted to 51 billion yuan, up 28% year-on-year. The processing of copper, tungsten, lithium and rare earth metals play a key role in Jiangxi's non-ferrous metals industry. The main direction of the industries' development is to achieve a higher level of production and utilization of end products. For this purpose, the province has formed a relatively complete industrial system including all stages of non-ferrous metal production – geological exploration, mining, casting, and processing.

The **petrochemical industry** is steadily moving toward a higher level of industrial agglomeration. The industry's products are in demand both domestically and internationally. For example, the proportion of technical gibberellin produced in Jiangxi accounts for more than 80% of the total production in the country, with production capacity ranking first in the world. In the Chinese market, the share of organosilicon monomer produced in the province is more than 25%, with production capacity ranking first in Asia. In addition, the market share of carbon black, gasoline anti-blocking agent and azodicarbonamide foaming agent in China market was more than 20%, with production capacity ranked first in the country. In 2022, the revenue of petrochemical industry amounted to 416.8 billion yuan.

The **building materials industry** is developing toward more environmentally friendly and technologically advanced production. The province is actively promoting the application of new and environmentally friendly building materials

products and related advanced technologies. The industrial agglomeration of industries such as cement and architectural ceramics ranks among the top in China. In the production of fiberglass, architectural ceramics and other building materials, the province ranks first in China. In 2022, the revenue of the building materials industry amounted to 350 billion yuan.

Efforts to accelerate the transformation and modernization of the **textile and garment industry** are being intensified. Paying special attention to the establishment of clusters such as, for example, Gongqingchengt down jacket cluster (urban county of Jiujiang City District of Jiangxi Province), Lianxi cellulose fiber cluster (urban sub-district of Jiujiang City District of Jiangxi Province), the province is striving to achieve the growth of garment industry sectors such as down jacket, knitwear, women's and children's apparel, etc., to achieve growth. In 2022, the gross revenue of the industry totaled 172.5 billion yuan, down 12.1% year-on-year. The export volume reached 6.5 U.S. billion dollars. The export volume reached 6.5 U.S. billion dollars, up 15.8% year-on-year, setting a new record for the province.

The **iron and steel industry** has established a "246" development model that emphasizes:

- two steel groups of companies – Xinyu Iron & Steel Group and Jiangxi Fangda Steel Group;
- four industrial bases – Jiujiang riverside iron & steel industrial base, Xinyu iron, steel and iron & steel processing industrial base, Jinxian steel structure industrial base and Pingxiang powder metallurgy industrial base;
- six product series – construction steel, steel for naval architecture and ocean engineering, for power transmission and transformer equipment, automobiles, household appliances and steel products.

The province's crude steel output reached 26.9 million tons, ranking it 14th in China, and the industry's operating revenue reached 312.4 billion yuan.

⁸ They include data on the performance of industrial enterprises with annual operating income of at least 20 million yuan.

Strategically growing industries have a decisive impact.

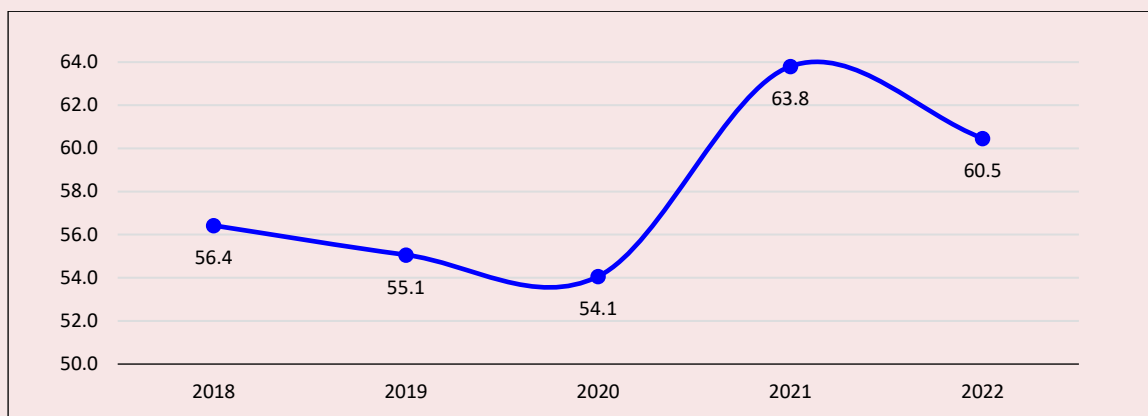
The promising industries of the Vologda Region specialization make a significant contribution to the region's economy. In total, their products account for more than 50% of the region's shipped products, the maximum indicator reached in 2021, amounting to 63.8% (Fig. 4).

Strategic emerging industries in Jiangxi Province also play a major role in the regional economy. They

account for more than a quarter of the value-added of industrial output, and their share is only increasing, up 3.9 p.p. year-on-year in 2022 (Fig. 5). The indicator has been characterized by positive dynamics for more than five years, in 2021 and 2022 its growth rate exceeded 20%.

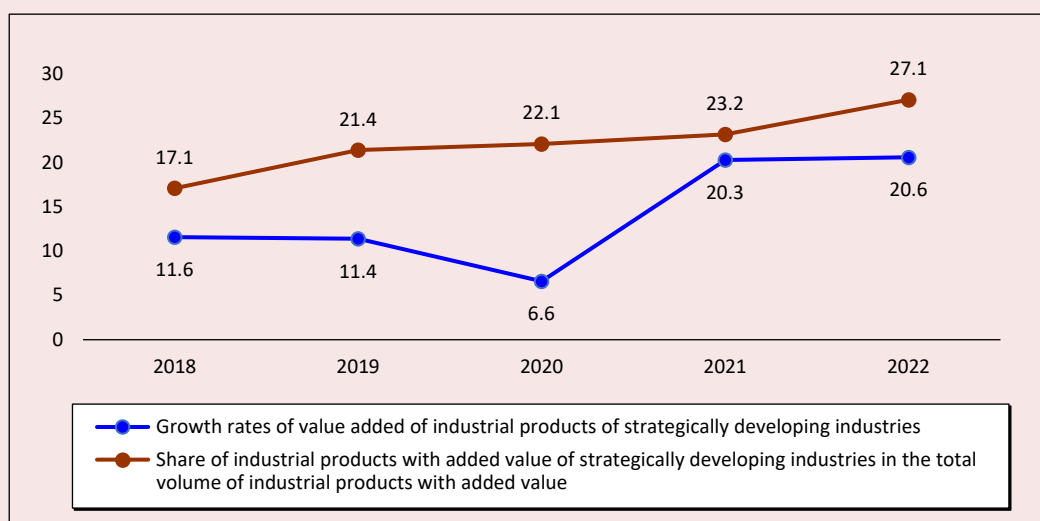
The above-mentioned industries are characterized by high profits showing significant growth. As mentioned above, the profit of electronic information manufacturing in 2022 was about

Figure 4. Share of shipped products of promising industries of the Vologda Region specialization in 2018–2022, %



Source: own compilation based on Rosstat data.

Figure 5. Development of strategically emerging industries in Jiangxi Province in 2018–2022, %



Source: own compilation based on the data from the National Bureau of Statistics of China.

1 trillion yuan, up 32.2% from a year earlier. Equipment manufacturing contributed about 720 billion yuan to the province's GRP, while the new energy industry contributed more than 400 billion yuan. Promising industries are also contributing to Jiangxi's economy. In 2022, the gross revenue of aviation enterprises totaled 160.5 billion yuan, up 13.5% from 2021; the province's Internet of Things industry grew from 50 billion yuan in 2018 to 190 billion yuan in 2022; virtual reality and VR enterprises grew from 4.2 billion yuan in 2018 to 81.2 billion yuan in 2022, increasing 19 times in the past four years. Meanwhile, the growth potential of the industries has not been exhausted, ensuring their development will achieve even greater figures.

Trends in the development of the digital economy.

Digital transformation of economic sectors contributes to increasing labor productivity, improving the quality of services and economic benefits (Lindquist, 2022). In Russia, this process, together with digitalization, is one of the five national development priorities, which is also associated with the task of increasing the efficiency of public administration, ensuring the sustainability and competitiveness of the country (Abramov, Andreev, 2022).

Among the Russian regions, the Vologda Region occupies average positions in terms of the level of digital transformation development. For instance, according to the corresponding rating of regional leaders, compiled by the Center for Expertise and Coordination of Informatization, the region ranked 39th in February 2025, having moved down 13 positions after the revision of the rating calculation methodology⁹. At the same time, the region is one of the leaders in the use of digital services for business. To achieve even greater results in this area, it is planned to create a mobile application

“Inspector”. It will allow for remote inspections of supplies via video communication, save photos and videos, and electronically sign final reports. This measure is aimed at reducing the burden on business, improving the quality and effectiveness of inspections¹⁰.

The degree of transformation of economic sectors reflects the digital maturity indicator, which includes indicators related to different spheres of economic activity, determining the percentage of processes using digital devices. According to its level, the Vologda Region takes only 57th place¹¹. The analysis of this indicator allows not only determining the current state of the region, but also predicting its position in the future in comparison with other regions. For example, if the digital transformation strategy is implemented, the Vologda Region will take 50th place in the rating of regions (Abramov, Andreev, 2023).

This process in the Vologda Region has several main directions. These are the development of digital maturity of the economy, introduction of information technologies in key industries, formation of own cloud technologies, provision of territories with wireless communication, etc. (Krylova et al., 2024). In addition, it is planned to develop feedback platforms in the region, primarily a quick feedback service that allows evaluating services provided to the public. To put these initiatives into practice, the Vologda Region is implementing the federal project “Eliminating digital inequality 2.0”, a macro-project to create a regional video analytics platform, as well as national projects “Digital economy” and “Data economy” that support small and medium businesses, IT companies, etc. An important area of activity is the training of highly qualified personnel in the field of

⁹ Ratings of Russian regions by information technology development. Available at: https://www.tadviser.ru/index.php/Статья:Рейтинги_регионов_России_по_развитию_информационных_технологий (accessed: March 18, 2025).

¹⁰ Digital transformation of the Vologda Region: new solutions-2024. Available at: <https://regcomment.ru/analytics/tsifrovaya-transformatsiya-vologodskoj-oblasti-novye-resheniya-2024/> (accessed: 21.08.2025).

¹¹ Digital maturity rating. Available at: <https://sicmt.ru/dmrating> (accessed: 18.03.2025).

IT industry in secondary and higher educational institutions of the region¹².

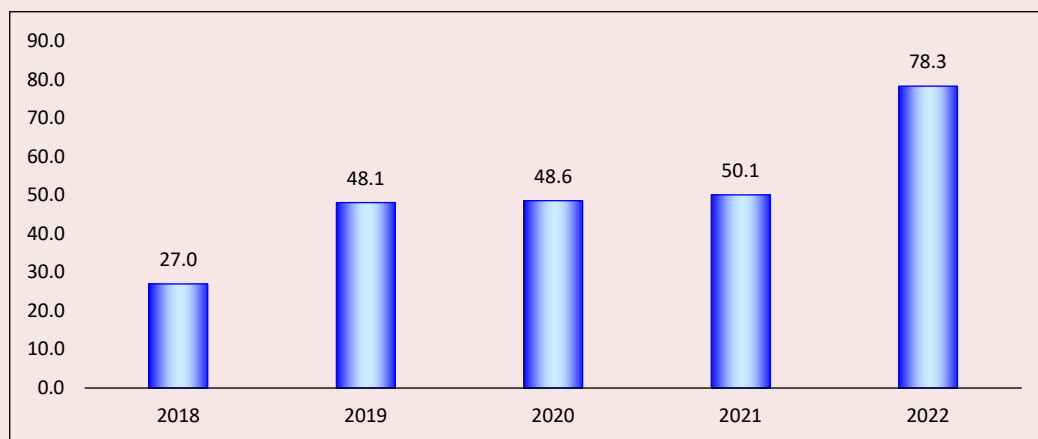
The digital economy in Jiangxi Province has started to reach the forefront, with large-scale efforts in key areas of the economy having a high positive effect on all areas of the economy. In 2022, the added value of this sector of the economy in Jiangxi Province reached 1.19 trillion yuan, up 14.4% year-on-year, and ranked second in China in terms of growth rate. It accounted for 37% of the province's GDP, up 2 p.p. from 2021. In the same year, a conference dedicated to the digital transformation of Jiangxi Province was held in the region. It presented scenarios for the use of digital technologies, designed in the format of a "list of possibilities" and a "list of products". Both lists include two hundred items each, and it is planned to invest about 8.2 billion yuan in their development¹³.

The digital industries in Jiangxi are constantly evolving, with 20 industries and economic sectors

being the main focus. The professional chip manufacturing industry is the most prominent, as indicated by the 160.4% revenue growth in 2022, indicating the increasing demand for the products. Other industries in Jiangxi Province, such as the Internet of Things and the digital services sector, are also showing gradual revenue growth, with increases of 14% and 9%, respectively.

The province is accelerating the integration of the digital and real economy as part of the implementation of the 14th Five-Year Plan. This is supported by the implementation of cloud big data and artificial intelligence initiatives, which promotes the comprehensive transformation and modernization of all sectors of the economy. In 2022, the province's development index for the integration of industrialization and informatization reached 78.3, increasing by 28.2 over the year (*Fig. 6*). The province's smart manufacturing maturity index reached 2.49, showing an increase of 0.02 points.

Figure 6. Development index of industrialization and informatization integration in Jiangxi Province in 2018–2022, units



Source: own compilation based on the data from the National Bureau of Statistics of China.

¹² Plans for digitalization have been outlined in the Vologda Region. Available at: <https://vologda.mk.ru/social/2024/02/26/plany-po-cifrovizacii-oboznachili-v-vologodskoy-oblasti.html> (accessed: 20.08.2025).

¹³ China's Jiangxi Province is experiencing a digital economy boom. Available at: <https://rossaprimavera.ru/news/53e1ec92> (accessed: 20.08.2025).

The digital economy development is impossible without the appropriate infrastructure. Progress is being made everywhere to create a suitable environment, which affects not only production directly, but also the living conditions of citizens. For example, to ensure the availability of the 5G network in 2022, 27,813 base stations were installed in each community in Jiangxi, and a total of 88,529 base stations were built in the province. In 2022, Ganzhou, Jian, Yintan, Yichun, Fuzhou and Pingxiang were included in the list of gigabit cities in China, bringing the total number of Jiangxi cities complying with the gigabit standard to nine, ranking the province fourth in China and first among the country's central regions.

Barriers to promoting synergies between digital intelligent transformation and green development.

1. Weak competitiveness of industries due to their concentration in the middle and lower tiers of value chains (VCs)

Most of the manufactured products are localized in the middle and lower links of the VCs, which does not allow the manufacturing industry to take a competitive position in the world market. The Vologda Region is characterized by the problem consisting in the small size of regional chains, which include mainly two or three stages of production. The mentioned circumstances negatively affect the GDP growth rate, reduce the investment attractiveness of regions, lead to the development of deindustrialization processes, etc. (Sidorov, 2022).

Industry suffers from a general lack of strength, remaining at a low development level, relying mainly on basic processing and simple assembly methods to produce low-quality and low-value-added products. Jiangxi also needs to address the “four surpluses and four deficiencies”¹⁴.

¹⁴ The problem of “four surpluses” refers to the high share of traditional, low-technology, resource- and labor-intensive industries in the industrial structure. The problem of “four deficiencies” implies the lack of developing, high-tech, capital-intensive, and high value-added industries.

2. Lack of key technologies in the main economic sectors to build a new model of industrial development.

This manifests itself in three aspects:

- technological capabilities of production equipment vary greatly from one enterprise to another. For example, Jiangxi Copper Corporation Limited and PAO Severstal use advanced technologies for smelting and processing of non-ferrous and ferrous metals, while small and medium-sized enterprises are hampered by outdated equipment;

- insufficient integration of industrialization and informatization. Actions are being taken to intensify this process. For example, Jiujiang City District supports private businesses to form special funds for their integration, and creates demonstration models, but these measures are not enough due to the small territorial coverage;

- underdeveloped and weakened growth in the producer services sector, which includes e-commerce platforms as well as the financial services sector, such as public databases and non-ferrous metal trading centers.

3. Uncertainty in the VCs, compounded by the difficulties of their factor-based transformation.

Jiangxi Province primarily lacks leading companies in the field of traditional Chinese medicine (TCM). Although companies such as Jemincare and Qingfeng Pharma Group occupy a respectable position in the Chinese TCM industry, there is still a certain gap between them and the leading domestic and world-renowned companies. There is also a lack of efforts in research and development of TCM technologies.

Conclusion

Based on the research results, we formulated a number of proposals to improve the interaction between digital intellectual transformation and environmental development in the promising industries of Jiangxi Province and the Vologda

Region based on the experience of Russian and Chinese regions in accordance with the national strategic plans of the states. Their implementation requires the use of the regions' strengths, the formation of a modern industrial system based on their competitive advantages.

1. Emphasize the primary role of industrial clusters in strategic emerging industries to accelerate the adoption of digital smart technologies.

One of the initial priorities is the creation of advanced manufacturing clusters. Improving the quality of manufacturing has traditionally been a top priority for both regions. It is required to create advanced clusters to accelerate the pace of re-engineering of the industrial base and progress of basic technologies and equipment.

We suppose that it is necessary to include the following in the list of advanced clusters at the national level:

- electronic information cluster in the economic and technological development zone of Jinggangshan Urban County (Jingdezhen Urban District);
- helicopter cluster in the high-tech industrial development zone of Jingdezhen Urban District;
- the mobile Internet of Things cluster in the high-tech industrial development zone of Yingtan Urban District.

In the Vologda Region, according to experts and representatives of regional enterprises, it is promising to form the following clusters:

- industrial cluster of robot manufacturers;
- interregional cluster for the manufacture of pulp and paper products;
- food production cluster¹⁵.

The implementation of these measures will be facilitated by encouraging closer cooperation between clusters and investment institutions. In this

regard, it is necessary to establish fund programs that leverage each institution's expertise in investment and key productive sectors, to accelerate the transition from old to new drivers.

2. Focusing on the development of traditional industries to promote the integration of digital and intellectual transformation and green development.

Under this direction, it is important to accelerate digital transformation in the first place. To this end, we should actively develop 5G communication technologies, form industrial internet platforms and guide enterprises to transition to them, promote a general overview of digital transformation for enterprises, and coordinate efforts to implement cloud-based big data and artificial intelligence initiatives.

For Jiangxi Province, the establishment of ecological and low-carbon development system of traditional industries is of special significance. Supporting the circular economy is necessary in Yintang, Fengcheng and other areas. This requires the widespread application and promotion of integrated resource utilization technologies, and increasing the level of processing in key industries such as copper and lithium smelting and fabrication, and construction materials. In addition, we should boost service-oriented manufacturing, create a platform for the comprehensive development of traditional industrial clusters, and encourage enterprises to network cooperation and personalized customization.

3. To develop the digital economy, emphasis should be placed on industries integrated with the real sector.

The implementation of this direction requires the creation of applied digital economy scenes using "VR+", "5G+" and "blockchain+" technologies, the need for which has grown even as the COVID-19 pandemic and its associated restrictions have spread (Li Zhimen et al., 2021). The latter involve demonstration zones, laboratories, and the

¹⁵ Three industrial clusters were proposed to be created in the Vologda Region. Available at: <https://vo.rbc.ru/vo/15/05/2024/6644a0d29a7947aaf2fbbd26> (accessed: 20.08.2025).

creation and selection of pilot projects. There is a need to strive for more replicable and promotable application scenes of digital transformation in the manufacturing industry.

Further, it is required more efficient utilization of data elements. It is important to encourage market players to legally collect them, actively promote the development of industrial parks and big data demonstration bases, conduct research on data ownership, handling, transaction, access and supervision, and build reliable infrastructure. It is also necessary to emphasize the industrial aspects of the digital economy, intensify efforts to integrate with the real sector, and accelerate the development of subsectors such as electronic devices and components, semiconductor lighting, and intelligent terminals.

4. Optimize VCs implementation models and create a platform for the interaction of digital-smart transformation and green development.

One of the priority tasks is to accurately identify the key areas of transformation of industrial chains. Focusing on specific sectors, it is necessary to promote the expansion of VCs in promising sectors and facilitate their modernization in traditional sectors of specialization.

A prerequisite for the implementation of these measures, as well as for ensuring sustainable economic growth of the regions as a whole, is the targeted stimulation of investment activity and improvement of the investment climate (Yang, 2017). The main emphasis should be placed on development zones to improve the overall level of service of projects throughout their life cycle, focusing on enterprise ratings, in particular, the Global 500, nationwide, regional and sectoral. By forming an innovation consortium and community of interest with other enterprises in the industrial chain, key industries can move from “point-to-point expansion” to “chain-based development”.

It is equally important for Jiangxi Province to modernize the industrial chain leader system. Based

on the experience of advanced models such as Shanghai’s “industrial internet with chain master authority” and Hangzhou’s “chain master factory”, the province should adopt the model of “chain leader + chain master”, establish a consistent system of interaction between leaders and masters, and promote the growth of chain master enterprises. Jiangxi Province should also promote another model, “chain leader + industrial park”, in which leaders can guide the integration of cities, counties and industrial parks into the provincial industrial chain scheme.

5. Promoting the industrial application of science and technology and taking multiple measures to optimize the innovation ecosystem.

Priority should be given to promoting the industrial application of scientific and technological advances. Integration with higher education and scientific centers is necessary. Licensing of S&T achievements for small and medium-sized enterprises on the basis of higher education institutions and regional centers of the Academy of Sciences seems possible. The license fee can be paid by the methods of “zero threshold fee + stage-by-stage payment + income commission” or “deferred payment”.

Encouraging the development of innovative technologies and enterprises is important. Leading companies should be supported to build industrial internet platforms, discover advanced technologies and application scenes, and develop replicable and promotable industry-specific digital solutions. In addition, for Jiangxi Province, it is necessary to intensify efforts to establish a list of key enterprises in the Poyang Lake National Innovation Demonstration Zone and support leading systemically important enterprises to become stronger and larger by applying one policy to one enterprise, thus creating a series of master-chain enterprises.

The implementation of measures in this direction requires the early deployment of digital

infrastructure construction. The goal of the regions is to stay at the forefront of industry trends while implementing an accelerated action plan for key sectors of the digital economy and promoting new industries and business models. The research and development of virtual industrial parks and clusters should be a priority in the emerging Nanchang Future Tech Hub, along with the acceleration of virtual agglomeration, platform operation and networking of industrial resources.

The novelty of the study lies in the identification of the main trends of digital intelligent transformation and green development of industries in the Vologda Region and Jiangxi Province, as well as in the formation of a set of measures aimed at activating their interaction. The practical significance of the study lies in the possibility of using the results obtained by the authorities in the development of regional strategic documents and the formation of structural policy directions.

References

- Abdulkadyrov A.S., Idrisov I.M. (2022). Issues of development and implementation of projects in the field of alternative energy in modern conditions. *Industrial'naya ekonomika*, 4, 236–240 (in Russian).
- Abramov V.I., Andreev V.D. (2022). Digital transformation of state and municipal governance: International experience and priorities in Russia. *Munitsipal'naya akademiya*, 1, 54–63. DOI: 10.52176/2304831X_2022_01_54 (in Russian).
- Abramov V.I., Andreev V.D. (2023). Analysis of strategies of digital transformation of Russian regions in the context of achieving national goals. *Voprosy gosudarstvennogo i munitsipal'nogo upravleniya=Public Administration Issues*, 1, 89–119. DOI: 10.17323/1999-5431-2023-0-1-89-11 (in Russian).
- Akberdina V.V., Romanova O.A. (2021). Regional industrial development: Review of approaches to regulation and determining of priorities. *Ekonomika regiona=Economy of Region*, 17(3), 714–736. Available at: <https://doi.org/10.17059/ekon.reg.2021-3-1> (in Russian).
- Bents D.S., Rezepin A.V. (2023). Medium-term trends in economic and technological development of metals industry regions. *Journal of New Economy*, 24, 3, 91–118. DOI: 10.29141/2658-5081-2023-24-3-5
- Brink I.Yu., Kolbachev E.B., Sirotkin A.Yu. (2010). Management of modernization of production systems of industrial enterprises. *Vestnik YuRGTU (NPI)*, 4, 4–17 (in Russian).
- Bugryshev A.L., Panikarova S.V. (2024). Optimization of production stocks as an element of the anticrisis strategy of an industrial enterprise. *Economics of Enterprises and Industrial Complexes*, 2, 23–34. DOI: 10.33917/mic-2.115.2024.23-34
- Galimulina F.F., Shinkevich M.V., Barsegyan N.V. (2023). Development of the financial flow model for the sustainable development of an industrial enterprise. *Journal of Risk and Financial Management*, 16(2), 128.
- Jie G., Jiahui L. (2023). Media attention, green technology innovation and industrial enterprises' sustainable development: The moderating effect of environmental regulation. *Economic Analysis and Policy*, 79, 873–889.
- Krylova N.P., Aleshina D.A., Belyakov I.V. (2024). Information and digital technologies of leading industrial enterprises of Vologda Region. *Sotsial'no-ekonomicheskoe upravlenie: teoriya i praktika*, 20(2), 46–55. DOI: 10.22213/2618-9763-2024-2-46-55 (in Russian).
- Lapidus L.V., Leont'eva L.S., Gostilovich A.O. (2019). Minimum digital basket of Russian regions for industry transformation. *Gosudarstvennoe upravlenie. Elektronnyi vestnik*, 77, 212–228. DOI 10.24411/2070-1381-2019-10025 (in Russian).
- Lenchuk E.B. (2020). Scientific and technological development as a factor in accelerating economic growth in Russia. *Nauchnye trudy Vol'nogo ekonomicheskogo obshchestva Rossii*, 222(2), 126–134. DOI: 10.38197/2072-2060-2020-222-2-126-134 (in Russian).
- Li Z., He L., Zhong Z., Xia Y. (2024). Financial–industrial integration, green technology innovation, and enterprise's green development performance: An empirical analysis of 625 listed industrial enterprises of China. *Environment, Development and Sustainability*, 26(2), 4029–4054.

- Li Zhimeng, Lukin E.V., Sheng Fangfu, Zeng Wenkai (2021). Assessing the impact of the COVID-19 pandemic on the economies of China and Russia. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast*, 14(5), 277–299. DOI: 10.15838/esc.2021.5.77.16 (in Russian).
- Lindquist E.A. (2022). The digital era and public sector reforms: Transformation or new tools for competing values? *Canadian Public Administration*. 65, 3, 547–568. DOI: 10.1111/capa.12493
- Ma Hui, Li Zhimeng, Cheng Xiumin, Pechenskaya-Polischuk M.A., Malyshev M.K. (2025). Development of the lithium industry in Russia and China in the context of energy transition and achieving carbon neutrality. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast*, 18(1), 135–151. DOI: 10.15838/esc.2025.1.97.8 (in Russian).
- Mel'nikov A. E. (2019). Investment processes and structural changes in the economy of old industrial regions of the Northwestern federal district. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast*, 12(2), 91–102. DOI: 10.15838/esc.2019.2.62.5 (in Russian).
- Porfir'ev B.N., Borisov V.N., Budanov I.A. et al. (2017). *Modernizatsiya promyshlennosti i razvitie vysokotekhnologichnykh proizvodstv v kontekste "zelenogo" rosta* [Industrial Modernization and Development of High-Tech Industries in the Context of Green Growth]. Moscow: Obshchestvo s ogranichennoi otvetstvennost'yu "Nauchnyi konsul'tant".
- Rumyantsev N.M. (2023). Promising economic specializations within a macroregions (the case of the Northwestern Federal District). *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast*, 16(6), 74–90. DOI: 10.15838/esc.2023.6.90.4 (in Russian).
- Rumyantsev N.M., Leonidova E.G., Gubanova E.S. (2022). Defining sectoral priorities of the region's structural transformation by searching for promising economic specializations. *Economic and Social Changes: Facts, Trends, Forecast*, 15(6), 94–109 (in Russian).
- Shi Zh., Ma L., Wang X. et al. (2023). Efficiency of agricultural modernization in China: Systematic analysis in the new framework of multidimensional security. *Journal of Cleaner Production*, 432, 139611. DOI: 10.1016/j.jclepro.2023.139611
- Shirokova E.Yu., Leonidova E.G. (2022). Assessment of the impact of the technological nature of the regional economy on the dynamics of its development. *Nauchnyi zhurnal NIU ITMO. Seriya: Ekonomika i ekologicheskii menedzhment=Scientific journal NRU ITMO. Series "Economics and Environmental Management"*, 3, 119–127. DOI: 10.17586/2310-1172-2022-17-3-119-127 (in Russian).
- Shirokova E. Yu., Lukin E. V. (2023). Functioning of manufacturing sector of the north-west Russian economy in 2022–2023: Expectations and reality. *Problemy razvitiya territorii=Problems of Territory's Development*, 27(6), 44–63. DOI 10.15838/ptd.2023.6.128.4 (in Russian).
- Shirov A. A., Belousov. D. R., Blokhin A. A. et al. (2024). Russia 2035: The new quality of the national economy. *Problemy prognozirovaniya=Studies on Russian Economic Development*, 2(203), 6–20. DOI 10.47711/0868-6351-203-6-20 (in Russian).
- Sidorov M.A. (2022). On accelerating the economic growth of Russian regions based on the development of interregional value chains. *Problemy razvitiya territorii=Problems of Territory's Development*, 26(5), 10–23. DOI: 10.15838/ptd.2022.5.121.2 (in Russian).
- Tolstykh T., Shmeleva N., Gamidullaeva L., Krasnobaeva V. (2023). The role of collaboration in the development of industrial enterprises integration. *Sustainability*, 15(9), 7180.
- Uskova T.V., Kozhevnikov S.A., Lukin E.V. et al. (2022). *Rossiiskie territorii: 30 let v usloviyakh rynka* [Russian Territories: 30 Years in the Market Conditions]. Vologda: VolNTs RAN.
- Uskova T.V., Lukin E.V., Vorontsova T.V., Smirnova T.G. (2013). *Problemy ekonomicheskogo rosta territorii* [Problems of Economic Growth of the Territory]. Vologda: ISERT RAN.
- Yang Lu. (2017). Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration*, 6, 1–10. DOI: 10.1016/j.jii.2017.04.005

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