Modern transformation of the production base in the conditions of Industry 4.0: problems and prospects

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Abstract. The defining trend of the Fourth Industrial Revolution taking place on the basis of Industry 4.0 is the digitalization of technological processes for creating new value in material production. The introduction of global trends of the Industry 4.0 concept into the practice of domestic enterprises, the importance of global trends for domestic industry require the search for new scientific approaches to research and systematize the manifestations of digitalization, take risks and dangers into account, and develop appropriate industrial policy measures. The study analyzes the main technologies and tools of the Industry 4.0 concept, the possibilities of its use for the progressive transformation of Russia industrial complex. The current trends and promising areas of innovative transformation of the industrial sector of the Russian economy are determined taking into account the identified specific features of Industry 4.0.

1. Introduction

For a little over 100 years, Russian industry has undergone a number of serious fundamental transformations. Firstly, quite advanced production facilities that were in tsarist Russia during the 1917 revolution were destroyed. Secondly, the global renewal and construction of all production in times of industrialization. Industrialization brought the USSR to a cohort of world production giants with a diversified structure of plants and factories. Thirdly, the transition to the capitalist model in the 1990-s led to the collapse and strong reindustrialization of production. At the same time, the privatization of a number of factories has also led to a change in the management of industrial development. Now, the industrial sector of Russia economy is on the verge of new changes. These changes are associated with the introduction of digital technology and the modernization of industry as part of the concept of Industry 4.0 [1]. The beginning of the fourth industrial revolution is associated with the development of digital technologies, the creation of information technology, deeper penetration of global networks, the widespread use of artificial intelligence and machine learning. Elements of cyber-physical systems that are able to track physical production processes, use a virtual
copy of the physical world and make independent decisions based on the analysis of a large amount of data are becoming common today in industry [2]. This concept is relevant and necessary for a radical modernization of Russian industry, with the effective use of which the Russian economy has every chance to become one of the leaders in world technological development.

2. Materials and methods
The main goal of this study is to develop the profile outlines of a new industrial framework of Russian industry under Industry 4.0. To achieve this goal, the following tasks:

- analyze the basic technologies, tools and the legal framework of the concept of Industry 4.0 and the possibilities of their use for the digital transformation of Russian industry;
- identify current trends and promising areas of digital transformation of the industrial sector of the Russian economy, taking into account the identified specific features and capabilities of Industry 4.0.

The study used methods of factorial, retrospective, economic-statistical, comparative and graphical analysis, a method of expert assessments, which allowed the authors to solve the tasks.

3. Results
Industry 4.0 is based on several technologies that must be integrated into production. These technologies are essential for realizing all the benefits of Industry 4.0.

Structure concept “Industry 4.0 is quite complex. It covers many technologies and is used in various contexts. Several technologies define the concept. The key effect is that technology integration creates opportunities that were not previously possible.

“Big Data” is a system that is a source of data. Each production generates a lot of information every second - the temperature of each machine, the operating time after the last service, the remainder of the materials at the moment, and another million different indicators. Now, it is realistic to collect all this data, but the human brain and standard working methods and available digital processing software products do not allow to process this entire data array so fast as to make the same fast management decisions. The new field of knowledge "Data science" allows you to process all this information. In most cases, even the initial processing of data allows you to detect problems in production and quickly fix them. However, if we talk about deep data processing and the construction of machine learning models, then these models can replace entire departments of corporations. This can significantly increase production efficiency at relatively low cost [3].

"Smart Factory" will ensure the continuous implementation of qualitative and quantitative actions aimed at achieving the production goal. Products at such a factory are also smart, with built-in sensors that are used over the wireless network to collect real-time data. Smart products also have management and processing capabilities. Thus, they can control their logistic path in the production process and even control and optimize the production workflow that concerns them. In addition, intelligent products are able to control their own condition throughout their entire life cycle, including during their service life and application. This provides proactive condition-based maintenance, which is especially valuable for products embedded in larger systems [4-5].

A continuous flow of information between devices and components, interaction between machines (M2M), production systems and actors should be established. Thus, machines, products and factories can connect and exchange data via the Internet of things (mainly based on a wireless network). This mix will allow smart factories to take shape, as the equipment will efficiently use the data for manufacturing, moving, reporting and training at amazing speeds. Accordingly, without the Internet of things, the concept of Smart factory is impossible. We can say that a smart factory is the development of a concept on an industrial scale for the goals and objectives of industry.

Five years after the introduction in Germany, the concept of Industry 4.0 became known worldwide, and it was transferred from its original field of application in industrial production to other
areas of mechanical engineering and non-engineering equipment. Relevant concepts, such as Logistics 4.0 and Education 4.0, have in common with the initial value of Industry 4.0 only widespread use of ICT tools, the ability to connect, collect and analyze data in real time. Now, there are very few enterprises in Industry 4.0, mainly new enterprises created to confirm the concept. It can be expected that most enterprises will introduce concept elements gradually and based on existing equipment and software solutions, which will not jeopardize the stability of their production [6].

4. Discussion
In Russia, the Industry 4.0 concept was available until 2035. Among the main technologies, the points necessary for the Industry 4.0 concept are also visible. For example, the industrial Internet is highlighted here, that is, in fact, the Smart factory technology, which is not in the NTI. We can say that this concept is highlighted as necessary for the further development of the digital economy of Russia. In addition, in the development strategies of individual regions, you can find plans for the introduction of similar technologies in certain industries. However, the problem is the lack of regulation of certain technologies, for example, distributed registry systems (block chain), the Internet of things, etc. Since there is currently no legal regulation of these technologies, they cannot be officially evaluated and put on the balance sheet of the company. There are also restrictions on their use in state enterprises and enterprises that work with the state [7].

Thus, in Russia there are programs and legal acts that set the task of developing and implementing the constituent elements, and therefore the very concept of Industry 4.0. However, there are problems regarding the regulation of specific technologies. For example, the legislative bodies of the Russian Federation have considered the issue of legislation on crypto currencies and block chain for several years, but there is still no clear understanding in what form and when the document will be adopted to regulate this technology.

The concept of "Industry 4.0" was necessary to overcome the slowdown in labor productivity growth in developed countries. Russia is significantly behind the leaders in this indicator. Labor productivity in Russia is more than 2 times lower than in the United States. Russia has so far failed to enter the trajectory of stable growth in labor productivity: this has been especially clearly seen in recent years, when periods of productivity growth have alternated with periods of decline in this indicator. Figure 1 reflects this situation well [8].

Figure 1. Labor productivity index in Russia in 2002-2018.
It follows from this that Russia is faced with the task of ensuring the growth of labor productivity and making it stable and accelerating. According to a study conducted in February 2017 by the CSR, the vast majority of manager’s surveyed of Russian industrial enterprises (83.6%) consider that raising the technical level of production is a key internal condition for increasing labor productivity. Accordingly, the concept of Industry 4.0 is a solution to the current problem. The concept provides off-the-shelf technologies that must be integrated into the industry to increase productivity. However, not all so simple. There is a shortage of specialists who can develop and implement such solutions in production. IT specialists are in great demand in the world, and often-Russian specialists leave to work in foreign companies. This issue should also be resolved for the organic development of industry.

The next problem and area for potential is the old equipment and its wear. At the same time, investments in fixed assets continue to fall. Figure 2 reflects an even worse trend - not only investments in fixed assets fall, but also the share of investments in fixed assets aimed at modernization [8].

![Figure 2](image)

Figure 2. The share of investments aimed at reconstruction and modernization in the total volume of investments in fixed assets in the Russian Federation in 2005-2018, in percent.

On this basis, it is necessary to increase investments in fixed assets and the share of investments in modernization. Despite the difficult situation now, a low base can now give strong results after the update. The new equipment will be ready to work within the framework of the Industry 4.0 concept. With the right investments, Russia can quickly get an industrial sector that works on the principles of this concept. In addition, the average productivity of Russian industry may be higher than the productivity of a country that modernized 20-30 years ago. Russia ranks 6th in the world in terms of robot and automation potential. It is ahead of China, India, the United States, Brazil and Indonesia. The reason is that in Russia there are a lot of outdated industries that are engaged in fairly ordinary tasks. Many operations can be replaced by industrial robots, resulting in an increase in productivity and production quality. In addition, Russia has the necessary scientific, technical and personnel base, which will quickly introduce industrial robots in production.

The Russian economy has great potential to reduce costs and increase productivity, since any program and robot performs routine tasks much faster and more efficiently, on the other hand, this will entail a strong increase in unemployment in the country and a decrease in demand.

However, at the moment, the level of digitalization in Russia is lower than the European average. And this is an additional problem for introducing the concept of Industry 4.0. In terms of the Digital Economy and Society Index, which reflects the country's digitalization level, Russia has a rating of 47.5 compared to the European average of 58.9. Figure 3 shows the ranking of countries by this indicator in 2018. And this is a strong opportunity for the development of the country and industry. It was said above that the concept of Industry 4.0 can reduce production costs and bring other benefits. Digitalization of the economy has similar advantages and can increase the efficiency of the national economy. In addition, just from the introduction of the Industry 4.0 concept, the digitalization of the whole country will increase significantly. However, in terms of other indicators, Russia is not far behind - the average number of devices connected to the Internet per person and the percentage of people who use the Internet daily [9-12].
In Russia, there are already examples of digitalization of production and implementation of the Industry 4.0 concept. For example, the company Sibur. The company believes that digitalization brings a number of important advantages to the company - a tool for increasing efficiency, quality management decisions based on data, the image of a modern technology company to attract talent, and others [13-14]. The company already uses the technologies of Industry 4.0 in its work - drones for technical inspections of plants and pipelines and machine vision for monitoring production [15-16].

The introduction of these technologies has reduced costs and industrial safety risks. Sibur is a successful case for the implementation of digitalization and the concept of Industry 4.0. Other companies may apply Sibur’s experience to their companies [17-19].

5. Conclusion

Thus, the concept of Industry 4.0 is necessary for the transition of industry to a new stage of development. The main goal of the new stage is the creation of mass customized goods without a significant increase in costs. And only technologies like Smart factory will allow this to be done. On the other hand, there is a potential problem that the development of this concept will cause an increase in unemployment and this may adversely affect the national and world economy. But this problem is solved. Firstly, this process is ongoing, and employees can reorient themselves to other opportunities. Secondly, the introduction of the concept is the creation of new high-tech jobs. Thirdly, human labor can become more productive and bring greater benefit, as a person can engage in more creative and creative work [20-22].

Speaking about current trends and key factors of Russia industry in the context of the Industry 4.0 concept, Russia currently has a number of problems that prevent it from making an instant technological breakthrough. Companies should start investing in fixed assets and increase the share of investments in updating and modernizing equipment. The modernization that has begun will launch digitalization in other related industries, as companies will understand the benefits of digitalizing production and working with the same digital enterprise.

Russia already has successful examples of implementing the Industry 4.0 concept. However, it is necessary to increase the number of such enterprises. In addition, the legal basis for this concept is and is necessary only legal acts that will regulate the specific technologies included in the concept. Russia has great potential in this direction, and it is obliged to use it.

Technological development within the framework of the concept of the digital economy involves the reorientation of various engineering and technological systems, which should affect both the high-tech sector of the economy and traditional industries, lead to the transformation of industrial development institutions, business models and the improvement of industrial policy.

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