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Industrial Management in the Digital Era. Russian and Global Experience

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INDUSTRIAL MANAGEMENT IN THE DIGITAL ERA. RUSSIAN AND GLOBAL EXPERIENCE

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Abstract

In the era of digitalization, an important task of industrial enterprises is to ensure effective activity when implementing modern information tools of Industry 4.0. "Industry 4.0" and "Quality 4.0 – are concepts closely related to the development process in production management, chain production, and quality management. These terms are also strongly associated with such a concept as the fourth industrial revolution. It is these principles that are the engine of progress in the era of digitalization, and are also a screening filter in the industrial sector.

The world economy is on the verge of profound changes comparable in scale to the onset of the first industrial revolution, the development of conveyor production or the invention of microchips. Technological progress allows us to achieve an increasingly high level of automation. Meanwhile, the almost universal ownership of smart devices in many parts of the world leads to a degree of interconnectedness that was previously unimaginable [7].

These developments, part of the fourth technology-based industrial revolution, have significant implications for investors, the global economy and the relative competitiveness of developed and developing countries. Thus, these changes are an interesting and important topic. These changes will have a variety of consequences for countries, businesses and individuals. Automation will continue to put pressure on the wages of low-skilled workers and will begin to affect the employment prospects of medium-skilled workers. On the contrary, the potential return from highly skilled and more adapted workers increases. Many labor-intensive industries should be able to increase the profit margin, as they replace expensive workers for cheaper robots or intelligent software. And a number of completely new companies and sectors will appear.

The article discusses the main aspects of industrial management in the digital era, reveals the Russian and world experience.

Keywords: industry 4.0, quality 4.0, digitalization, quality management.

Introduction

The digital economy is no longer a development prospect, but exists quite realistically, having a noticeable impact on all spheres of life. Experts believe that the use of modern information technologies in the commercial sector contributes to increased competition, the emergence of threats from transnational corporations, and increased dependence on foreign manufacturers. In addition, digital transformation is associated with such social risks as job cuts, the growth of social tension caused by the inability of labor and professional self-realization, total control of behavior.

Organizations are forced to take into account market development trends and introduce new technologies, otherwise, they risk falling behind the leaders, losing in the competition, and simply leaving the market. For organizations, digital transformation also has two sides. On the one hand, modern technologies contribute to the automation of routine processes, increase the manageability and efficiency of processes, and transparency of organizational activities. On the other hand, information technologies are developing very quickly, requiring constant costs for implementation, testing, personnel training, logistics, and technological support.

The relevance of studying and developing specific measures to ensure the risk management of digital transformation is due to the need to increase competitiveness and achieve the financial goals of the organization, reducing the negative impact of external and internal factors in conditions of uncertainty and high variability.

The purpose of this research is to reveal the essence of industrial management management in the digital age, as well as to analyze current Russian and world experience.

Materials and methods

When writing the work, methods of analyzing literary and documentary sources, internal and external environment, risk assessment and analysis, justification of management decisions were used.

Much attention is paid to the issues of digitalization. L. D. Alexandrova, I. S. Polushina [1] consider the impact of digitalization on the management of business processes, come to the conclusion that digitalization radically changes existing business processes, contributes to the optimization and efficiency of the organization's activities.

B. B. Kovalenko believes that it is precisely the possibilities of digital transformation that make it possible to create sustainable competitive advantages [2]. A similar position is held by Eling Martin and Lehmann Martin in the work "The Impact of Digitalization on the Insurance Value Chain and the Insurance of Risks". Based on the results of more than 80 studies, they conclude the increasing dependence of modern organizations on information technologies, which contributes to the development of organizations, but at the

same time requires significant resources and fundamental changes in the work. Jacobi Robert, Brenner Ellena believe that effective risk management, increasing the flexibility of management and organization of processes, is a prerequisite for development.

Questions about the development and digitalization of the modern economy each year are considered and disclosed in more details. As a basis for analyzing the global experience, the development strategies of such countries as China, Germany, the United States and Russia were studied directly.

And there are a large number of works of Russian scientists and researchers devoted to this topic. Among the most relevant are the works of Kharlamov A.V. and Kharlamova T. L. “Transformation of the Russian economic system: theoretical and practical aspects”, and Rodionov D. G. “Digital economy, smart innovations and technologies”.

Discussions

We would like to note that the existing studies on this topic mainly reflect the "picture" that emerged in the period from 2015 to 2018-2019. For the last 2 years the sphere of industrial management of Russia and other countries has been influenced by certain social factors (for example pandemic and consequences). Therefore, there is a need to update the data, that will describe the Russian and world experience of industrial management in the era of both digitalization and socio- economic conditions.

To date, the development of the world economy indicates a gradual weakening of the general economic situation: a decrease in investment activity, a decrease in import demand, an increase in protectionist trends, the emergence of trade wars, a deterioration in the global geopolitical situation, as well as a decrease in the growth rate of industrial production. As a result, “leading economic organizations, including the International Monetary Fund, the World Bank, and UNCTAD, were forced to revise previous macroeconomic forecasts downwards. As a result, the growth of global GDP in 2019 decreased from 3.8% to 3.6-3.7%. In addition, the dynamics of the physical volume of international trade in goods and services significantly slowed down from 5.3% to 4%” [4]. Also, according to UNCTAD, the global volume of foreign direct investment inflows decreased by 19% year on year, from $ 1.47 trillion to $ 1.2 trillion.

According to the United Nations (hereinafter – the UN), the leading developed country in terms of economic growth in 2019 was the United States – an increase of 2.9%, while the lowest rates were recorded in Japan – 0.9% and Italy – 1.0%. Among the countries with developing economies, the Republic of India took the highest topics (an increase in GD P by 7.3%), while in Argentina, as a result of 2019, GDP decreased by 2.6% due to the financial crisis. The economic growth rates of the countries are shown in table 1.

Table 1

The economic growth rates of the countries and the forecast for 2020 [3]

Countries	Growth rates, %				
	2017	2018	2019	2020	2021
1	2	3	4	5	6
World economy	2,5	3,1	3,1	3,0	3,0
Developed countries	1,7	2,2	2,2	2,1	1,9
1	2	3	4	5	6
USA	1,6	2,2	2,8	2,5	2,0
Japan	1,0	1,7	1,0	1,4	1,2
European Union	2,0	2,4	2,0	2,0	2,0
Developing countries	3,9	4,5	4,4	4,3	4,6
CIS	0,3	2,0	2,1	2,0	2,5
Russian Federation	-0,1	1,5	1,5	1,4	2,1
Africa	1,6	3,4	3,2	3,4	3,7
Southeast Asia	6,1	6,1	5,8	5,5	5,6
East Asia	5,7	6,1	5,8	5,6	5,5
China	6,7	6,9	6,6	6,3	6,2
South Asia	8,0	6,1	5,6	5,4	5,9
Republic of India	7,1	6,7	7,4	7,6	7,4
Western Asia	3,1	2,5	3,0	2,4	3,4
Latin American countries	-1,3	1,0	1,0	1,7	2,3
Brazil	-3,5	1,0	1,4	2,1	2,5
Mexico	3,1	2,4	2,4	2,5	2,3
Caribbean countries	-0,7	-0,4	1,9	2,0	2,0

Based on the UN forecasts, the world economy will experience moderate growth in 2021-2022. The most important factors of the slowdown in the global economy are due to the following factors:

- The growth of protectionist tendencies. The escalation of trade wars involving large countries, which leads to a reduction in not only trade and investment of the countries of the conflict but also entails a domino effect for other countries. As a result of trade conflicts, the institutional foundations of the world economy are being destabilized, and the effectiveness of integration groups is decreasing.

- Financial instability in emerging market countries.

- The high level of public debt, as well as household debt in several developed countries, hinders the growth of consumption and investment.

- Geopolitical tension, which does not allow maintaining stability in various regions of the world [12].

In addition, the prospects for commodity-exporting countries remain clouded by the decline in prices in 2014/15, which led to a sharp decline in the growth rate of the economy. Even though prices have partially recovered, they remain extremely unstable and are subject to significant fluctuations in the stock market, as evidenced by the sharp decline in oil prices in the fourth quarter of 2019.

These trends lead to a general decrease in the growth rate of world GDP, which entails a decrease in the growth of world trade as a result of the deteriorating conjuncture in certain commodity markets.

As a result of the deterioration of the overall global market situation, the IMF experts have reduced the growth rates of world trade. The main factors of this forecast were a decrease in GDP growth, a decrease in the pace of industrial production, as well as a decrease in demand. To a greater extent, the adjustment affected developed countries. The dynamics of world trade and the forecast of its development are presented in Table 2.

Table 2

Dynamics and forecast of global trade growth in the period 2017-2021 (basic scenario). [16]

	2017 г.	2018 г.	2019 г.	2020 г.	2021 г.
IMF (goods and services)	2.2	5.3	4.0	4.0	4.0
World Bank (Goods and services) United	2.6	5.4	3.8	3.6	3.5
UN (goods and services)	2.5	5.3	3.8	3.7	2.8
Other countries	2.5	6.7	5.8	4.1	3.6

International experts do not see any prerequisites that could accelerate the dynamics of international trade in the short or medium term. The leading factor is the trade war between the US and China. “Experts do not exclude that the transition to a protracted war may lead to a deterioration of the forecast, since other countries may be involved in the war and have already been involved, which could jeopardize the entire international trading system and greatly worsen the global investment climate” [14].

In the face of significant policy uncertainty and weakening prospects for global demand, industrial production growth has slowed, especially in the case of investment goods. This slowdown has spread to a wide range of countries, especially countries with advanced economies, except for the United States. A cyclical decline in economic activity in countries that were considered to have growth rates higher than potential was quite expected, but this decline turned out to be more significant.

Another important indicator of economic growth is the industrial production index. This indicator measures joint progress in both quantity and

quality, without taking into account the impact of prices. The index indicates changes in the volume of that part of the gross domestic product that is derived from industry, in other words, the gross value added to the cost of factors of various industries and the industrial sector as a whole. The index is used as an indicator of both supply-side and demand-side activity and is used by central banks to measure inflation since high levels of industrial production can lead to uncontrolled levels of consumption and rapid inflation. In addition, the index reflects the general situation in the industrial market. The industrial production index for the first half of 2019 is shown in Table 3.

Table 3

Industrial production index for the first half of 2020 [9]

Country	Industrial production index in 2020, %	Index adjustment, %
1	2	3
USA	1,2	- 0,8
UK	-0,7	0,5
China	4,8	-1,5
Germany	-5,3	0,9
France	-0,3	+0,1
Japan	-1,1%	-0,6
Italy	-0,7	+0,5

Based on the data in the table, we can conclude that today there is stagnation in industrial production. According to the results of 2020, the growth of the industrial production index in some industrial countries did not exceed 1-2%. “According to the Organization for Economic Cooperation and Development, from 2017 to 2020, industrial production increased by 3.1% in the United States, 4.6% in France, 2% in Germany, 2.9% in the United Kingdom, and 7.7% in Russia” [10]. Thus, these indicators confirm the low growth rates of industrial production in developed countries.

Based on this, we can conclude that the decline in GDP growth at the present stage is due to both economic and non-economic factors. And if the decline in the growth of world trade today is mainly due to the geopolitical factor, then the decline in the pace of industrial production is caused by economic and social factors.

Therefore, most developed economies are focused on the transition to a new, sixth technological order, which will have a positive impact on economic growth. “The main directions of development in the sixth technological order are nanotechnologies, renewable energy sources, digital technologies. The transition to the sixth technological order requires fundamental research and development, as well as high funding from both the state and the private sector of the economy” [6].

“It is worth noting that the transition to the sixth technological order requires the development of the digital economy” [5]. The global spread of

digital technologies creates the basis for the formation of a digital economy with new productive forces and production relations, which are a new development resource for both advanced countries and second-tier countries.

There is continuity between the fifth and sixth orders. “The basic innovations that form the core of these structures are information technologies. However, in the sixth, nano -, bio-and additive technologies are added to the existing information and communication technologies. Studies show that the process of transition to a new sixth technological order in different countries is at different stages, but the general trend is that the main driver of development is the developed digital economy” [15].

The digital economy is one of the main tools for the development of country economies. Thus, the development of the digital economy is of priority importance in the development of the economies of countries. To date, several programs are being implemented in developed countries within the framework of the development of the digital economy affecting the economic, social, industrial, and also the service sector. The World Digital Economy Development Index is presented in Table 4.

Table 4

World ranking according to the index of the digital economy in society in 2020 [19]

Country	Digital Economy and Society Index	Subindexes				
		Connectedness	Human capital	Using the Internet	Integration of digital technologies	Digital public services
1	2	3	4	5	6	7
Iceland	0,66	0,69	0,66	0,61	0,73	0,58
Republic of Korea	0,64	0,81	0,75	0,29	0,47	0,73
Norway	0,63	0,70	0,65	0,45	0,66	0,63
Japan	0,62	0,71	0,66	0,22	0,67	0,71
USA	0,62	0,66	0,56	0,37	0,68	0,79
China	0,61	0,75	0,61	0,30	0,78	0,49
Russia	0,47	0,50	0,63	0,32	0,43	0,36

“Based on the presented data, it can be concluded that today the leaders in the digitalization of the economy are developed countries” [19].

Results

According to the authors, such an aspect of the study of digitalization as risk assessment and management is not sufficiently developed. The presence of

risks is recognized, the designation of risks is presented, but no specific methods for minimizing the negative impact of digitalization risks are presented. This confirms the relevance of the chosen research topic.

Industry 4.0 is often used interchangeably with the concept of the fourth industrial revolution. This term hides a new stage in the organization and control of the production value chain (value chain). It is characterized by greater automation (compared to the third industrial revolution), the connection of the physical and digital world with the help of cyber-physical systems that are supported by industrial IoT (Internet of Things). The central industrial control system is fading into the background, instead of it, there are "smart" systems and products that determine the stages of production. To the characteristic differences, you can also add closed data models with personalization and product customization management systems.

The main goal of industry 4.0 is to ensure the autonomy of decision-making processes, monitoring of production assets and enterprise processes in real-time, as well as the creation of new value chains in real-time through early involvement of stakeholders and vertical and horizontal integration [11].

The term "industry 4.0" can be applied to any field of activity, but its connection and the art of managing an industrial enterprise have not been fully studied. This, in turn, creates a problem in identifying the main components of this concept. Despite this uncertainty, eight main components of industry 4.0 have already been formed, which are firmly established in this area and are actively used in modern industry (Fig. 1).

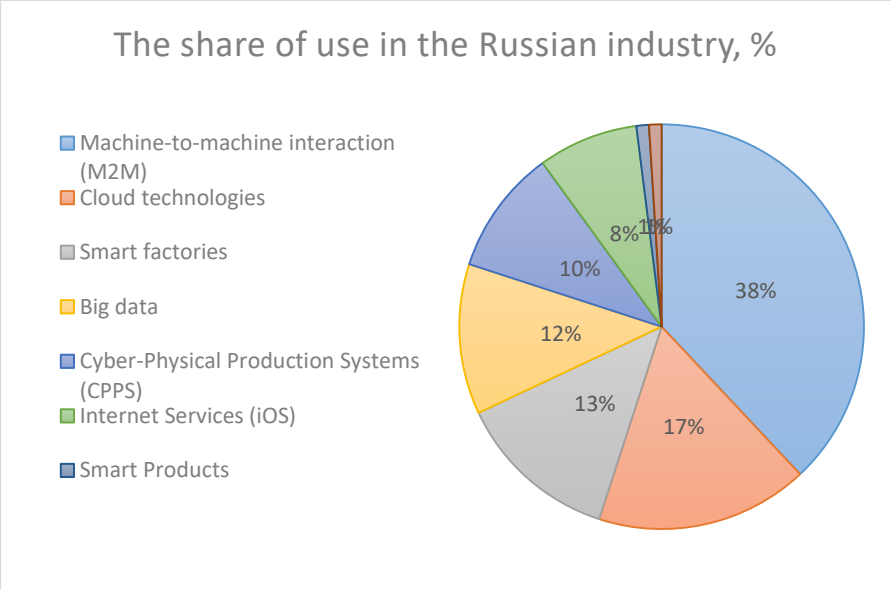

Figure 1 - Components of Industry 4.0 in Russian industry [18]

At the same time, at the moment, the most common terms in publications are cyber-physical systems, IoT, "smart" factories, as well as Internet services.

This means that these components are the most important in the industry, which makes their development a priority.

Cyber-physical systems form the basis of industry 4.0 (for example, "smart" machines). They are aimed at integrating computing and physical processes, for which they use modern control systems, have built-in software systems, and have an Internet address for connection and addressing via IoT. This means that computers and networks can control the physical production process in a certain process of the enterprise.

From all of the above, we can conclude that the main trend in this area is the integration of products and production methods into a single network, which implies close cooperation in to create new production methods, optimize and reduce costs in real-time.

Currently, Germany, as the leader of the global manufacturing industry, and the United States, as the leader of new technologies, especially in the information and communication sphere, have achieved the greatest success on the path of neo-industrialization and building a truly Technotronic society.

Initially, the German government published three industrial development strategies – in 2006, 2010, and 2012. The implementation option of the strategy was given the general name "High-tech Strategy Implementation Plan 2020". The Government allocates up to $ 10 billion annually for the implementation of the strategy. The last published document on the topic was called "Industry 4.0 Platform".

At the very beginning, Industry 4.0 develops research work, and then unites industry participants, and is a driver for the development of standardization. Industry 4.0 has been studied for 10-15 years and is based on the German government's high-tech strategy 2020. The initiative was launched in 2011 by a group of communication Developers of the Industrial and Scientific Research Alliance, which was convened and organized by the Ministry of Education and Research, which became institutionalized through the creation of the "Industry 4.0 Platform". A platform that currently serves as a central point of contact for politicians, businessmen, and scientists. The Ministry of Education and Research and the Ministry of Economy and Energy jointly allocated more than 200 million Euros to finance this strategy. The interested parties believe that the strategic measure to consolidate the German technological leadership in mechanical engineering has made it possible to reduce the separation process among industries, quickly switch to generally accepted practices in a fairly short period, and turn industrial projects into large-scale industries, thereby creating a platform for large companies [8].

The strategy has several problems related to the coverage of small and medium-sized enterprises. The strategy is primarily designed for the creation of large enterprises, the purpose of which will be to create global chains of automated production from the beginning to the end. For small and medium-sized enterprises, the implementation of the Industry 4.0 strategy is difficult, since it is necessary to justify the rationality of the created project – enterprise.

The Industry 4.0 strategy is aimed at ensuring the expansion and development of industry in Germany. It supports the integration of cyber-physical systems and the Internet of Things and Services to increase

productivity, efficiency, and flexibility of production processes and, consequently, economic growth. The goal of the Industry 4.0 initiative is primarily to ensure and develop Germany's leading position in the field of industrial production and to promote digital structural changes and create a basis for their achievement.

As a result of this program today, within the framework of the Industry 4.0 strategy, production is carried out in 79 industrial enterprises throughout Germany [9].

In the USA, the Industry 4.0 development Program was developed in 2013. Given the importance of industry for the United States, the interest in the development of Industry 4.0 has been supported by the US federal government in many ways. Thus, the state portal Advanced Manufacturing (advanced industry) was created. Many of the initiatives are related to the promotion of concepts in Industry 4.0 and the use of such concepts is being implemented to strengthen and develop the manufacturing sector in the United States. This portal contains a lot of information about advanced manufacturing in the United States, including the most promising sectors, which include certain companies, research bureaus, as well as projects involving public-private partnerships.

To date, the most developed are three initiatives. Launched in 2013, the Advanced Manufacturing Technology Consortium is a competitive grant program designed to create new or strengthen existing industry consortia that address priority challenges that hinder the growth of advanced manufacturing in the United States. The Consortium of Advanced Manufacturing Technologies program finances participation in the value chain, including small, medium, and large companies, universities, and government agencies

The Partnership Program for Investment in Industrial Communities is an initiative aimed at financing business plans. Through this program, the federal government encourages best practices-coordinates federal assistance to support long-term development plans;

The consortium in the United States is mainly represented by businesses – 170 companies from almost 30 countries, including Germany ones. Membership is open to everyone, fees depend on the scale of the business and companies.

We can generalize that Industry 4.0 belongs to the state, while the Industrial Internet Consortium in the United States is a private company.

“In the conditions of new industrialization, the development of the intellectual potential of all those employed in industrial production becomes decisive, and not only in the high–tech sector of the economy, where 1-2% of workers are concentrated, while the number of people employed in the entire industry is 20%” [20].

As for China, the "Made in China 2025" strategy is being implemented there. The creation of " Made in China 2025 "was initiated by the German" Industry 4.0 "and generally corresponds to the German and Japanese approaches to economic development and innovation Within 10-15 years, it is planned to"promote digital production by increasing digitization and combining products" [13].

China is striving to reduce its dependence on international technologies and modernize its manufacturing capabilities and intelligent manufacturing, ensuring that innovation, product quality, efficiency, and integration will stimulate production in 10 key industries. Further goals include increasing the awareness of Chinese brands and achieving green development goals. Green development will prove important for government strategies to combat climate change, address health issues, and the environmental impact of China's industrialization.

The emphasis on branding and product quality is made to win the international market and increase competitiveness. For example, in the agricultural sector, the goal is to create up to three recognizable brands and up to five internationally competing companies.

Reducing dependence on foreign technologies involves the creation and development of companies that can innovate through research and development, dominate within the country and produce competitive products. The main goal is to increase the internal content of the main components and materials to 40 percent by 2021 and 70 percent by 2025, which will contribute to self–sufficiency and, as the final goal, localization of the production process, but such goals violate WTO rules. “Although China is striving to move up the value chain, it also sees "Made in China 2025" as an opportunity to fully integrate into the global production chain and cooperate more effectively with industrialized countries” [13]. Even if the key goals are not achieved, this initiative will improve China's" overall economic governance " and strengthen its financial, educational, medical, and manufacturing sectors.

Thus, that this research could be the basis for developing specific methods for minimizing the negative impact of digitalization risks in the future.

Conclusion

Having considered all the strategies, it can be concluded that developed countries pay considerable attention to the development of industrial production. The target indicators indicate that a significant result will be achieved in the short and medium-term due to a fundamentally new approach to the organization of production. Although Industry 4.0 is aimed at increasing productivity, as well as reducing the resources consumed through the introduction of robots and digital technologies, at the same time, the average number of employees at such enterprises is decreasing, which leads not only to an increase in unemployment but also to a shortage of highly qualified personnel.

Previously, the growth of the world economy was associated with a small increase in global employment, although some caution should be exercised when interpreting, which gives an incomplete idea of the quality of jobs, which are discussed below.

“According to the International Labour Organization (ILO), the global unemployment rate in 2017 was 5.5%” [17]. In recent years, there has been a noticeable increase in unemployment in developed countries, while the average

unemployment rate is declining after the high level of the post-financial crisis - from 8.7% in 2010 to 5.4% in 2018. In several large countries, including Germany, Japan, and the United States, the unemployment rate is currently at its lowest level in recent decades. In all three countries, firms reported a shortage of skilled workers as a factor constraining the level of production growth.

To achieve industrial growth and transition to a new technological order, it is necessary to develop a new human capital development. The paradigm of "lifelong learning "comes to the fore. Within the framework of this paradigm, the education system is being revised, namely, the system of training personnel for Industry 4.0.

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