Digital Technologies in Key Sectors of the Economy in the Context of Global Competition

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Abstract. The intensive development and spread of digital technologies in recent years has significantly changed the face of key sectors of the economy and the social sphere. More and more organizations are seeking to transfer business processes to the digital environment, thereby significantly reducing transaction costs and significantly increasing the volume of economic activity. A giant, virtually barrier-free, market is emerging on the Internet with truly global competition and very high dynamics of all its elements (companies, products and services, consumers). Under such conditions, the ability to process and analyze large amounts of data becomes an important factor in competitive advantage.

1 Introduction

The beginning of the 21st century brought the rapid development of digital technologies based on the information revolution and the processes of globalization of the economy. The key and most important factor in the activity of market entities at present is the digitalization of business processes and management processes [1]. At the same time, digital transformation affects all levels, sectors and sectors of the economy. Digitalization activates the established markets for goods, services and labor, as well as the principles of the functioning of the public sector. At the same time, the most important aspect of the functioning of the economy in modern conditions is taking into account external global factors, including such as the spread of the Covid-19 pandemic. These changes in the economy require scientific understanding and emphasize the undoubted relevance and practical significance of the topic of the monograph, which reflects the issues of applying the cluster approach in the economy, the development of innovative clusters in a recession.

The sustainability and prospects for business development are determined by the ability to respond to changing customer needs many times faster than even some 20-30 years ago and quickly bring new products and services to the market through electronic sales channels. Today, the market value of many companies is largely determined by “digital assets” (the size and loyalty of the Internet audience, brand awareness and reputation in cyberspace, etc.). Their significance is illustrated by the fact that in recent years it is the digital giants (Facebook, Google, Microsoft, Apple, Amazon) that have achieved record

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market capitalization, and their combined value makes up a significant share of the entire S&P 500 stock index. Such strong market changes are associated with the spread of business models based on digital technologies. Here are just a few examples of such models [2].

The digital transformation of industry is based on similar concepts of Industry 4.0 and Factories of the Future, including digital ("paperless design and production") and smart ("unmanned production") factories and distributed networks of them - virtual factories. They involve the digitalization of the entire life cycle of products - from idea to disposal. The digital transformation of the industry relies on a whole range of advanced technologies, primarily virtual modeling, the Internet of Things (IoT), robotics, AI, big data, cloud computing, predictive analytics, additive manufacturing, etc. One of the important elements of digital transformation is the introduction of computer technologies. and supercomputer modeling and digital twins of products, followed by virtual testing and optimization. The basis for their application are software products for design and computer engineering based on mathematical and simulation modeling (CAD, CAM, CAE, etc.), product life cycle management (PLM) [3]. In production, smart factories are becoming widespread, which are characterized by a high level of automation of all processes and real-time control, taking into account constantly changing conditions. This is achieved primarily through a combination of Internet of Things technologies, big data analysis and information systems for managing production and business processes (MES, ICS, ERP, EAS, etc.). Smart factories also widely use robots, additive technologies (3D and 4D printing), industrial avatars controlled via neural interfaces, etc. After-sales service is now beginning to be perceived as a separate value proposition and an independent source of income. Thanks to digital technologies, it ensures the transition to a service business model ("goods as a service") and predictive maintenance (from "repair according to the regulations" to "repair on condition") [4]. This becomes possible, among other things, by analyzing big data about user experience and data from IoT devices installed on products. The digital transformation of industry not only leads to cost reductions and increases in labor productivity and product quality, but also reduces the time to market for products, provides mass customization and flexible production that quickly adapts to external changes. The world leaders in the digital transformation of industry are the countries of the Asia-Pacific region (China, Japan, South Korea), the European Union (Germany, France), the UK, the USA and Canada [PwC, 2020]. In Germany, 40% of enterprises are already using digital technologies, and 23% plan to implement them in the coming years [World Trade Center, 2020]. In Denmark, 66% of manufacturing companies use cloud services technologies, and 38% use industrial robots and automated lines [5]. In the Czech Republic, the Internet of things is being actively implemented - at 46% of the country's enterprises. Ireland is the leader among European countries in the use of AI technologies, as well as big data analysis, with 22% of industrial enterprises already using it. In Russia, advanced digital technologies are being introduced mainly by large industrial enterprises. However, most of them do not yet have a comprehensive digitalization program - companies are implementing packages of pilot projects to introduce separate and often disparate digital solutions.

2 Research Methodology

The most "popular" in the industry are cloud services (they are used by 27.1% of organizations), which provide processing of an ever-growing amount of data on production and business processes generated at enterprises (including from IoT devices). The 2nd place is occupied by industrial robots (17.2%), due to which a reduction in personnel costs, a consistently high quality of products, as well as an increase in the technological flexibility of production are achieved [6]. Among the most robotic industries are the automotive

industry, chemical and petrochemical industries. RFID is used by 16.5% of enterprises, primarily as part of production cycle control systems on conveyors and equipment operation. Digital platforms are used by 16% of manufacturing companies. Least of all industrial enterprises use digital twins (3.3%, which, however, is 3 times higher than the average for the economy) and AI (3.6%, which is lower than the average for the economy). ERP prevails among special software - 18.6%. For objective reasons, the level of use of software for designing and modeling products is also high - 16.3%, production process control systems (MES) - 11.6%, PLM / PDM are used to a lesser extent - 4% [7].

Industry digitalization is one of the key priorities for leading foreign countries. Automation and modernization of production with the help of digital technologies are paramount tasks within the framework of the strategic documents of the EU, the USA, China, South Korea, and Japan [16]. The digital transformation of industry is supported through various public policy instruments and measures, for example, grants for research and development in the UK [High Value Manufacturing Catapult, 2022], the creation of industrial technology laboratories in the Netherlands [Brainport Industries, 2022], the development of cooperation and the formation of clusters involving industrial enterprises in China [The Information Office of Hangzhou Municipal People's Government, 2021]. The approved strategy for the digital transformation of the manufacturing industries includes several priority projects [8]. The Smart Manufacturing project solves the problems of increasing the efficiency of using fixed assets, raw materials and materials, expanding the technological capabilities of enterprises, developing and implementing Russian software for key classes, as well as increasing the share of enterprises using predictive analytics and industrial Internet of things technologies. The Digital Engineering project will reduce the time to bring industrial products to the market, create universal marketplaces with resources for developing and selling products (from idea to market), form common data formats, and increase the share of enterprises using digital twin technologies and virtual tests [9]. The "Products of the Future" project involves the transition to a flexible conveyor production model (customization for the client), the introduction of predictive analytics technology to move from "repair according to the rules" to "repair according to the condition", as well as the introduction of a service model for the sale of industrial products and providing wide access to technologies.

3 Results and Discussions

The priorities of the digital transformation policy of the Russian industry are highly consistent with global trends, covering almost the entire product life cycle (design, production, service), the concepts of smart factories, mass customization, a service model for product sales, as well as a wide range of digital technologies underlying them (digital twins of products and processes, virtual tests, internet of things, predictive analytics, digital platforms) [10]. Particular emphasis is placed on the introduction of domestic industrial and engineering software, the development of electronic document management, as well as the development of staff competencies, including digital ones. At the same time, today almost no attention is paid to the introduction of industrial robots and AI, as well as additive technologies that can contribute to mass customization and accelerate the development and testing of products, primarily in mechanical engineering [11].

It is worth noting that one of the key difficulties in implementing the policy of digital transformation of the manufacturing industry is to ensure full coverage of enterprises - not only large backbone companies (including state-owned companies and state corporations), but also small and medium-sized private businesses must go through the transformation of production and business processes, which will allow creating new, more efficient production ecosystems based on digital platforms (including within the framework of the

concept of virtual factories) [17]. Thus, it is advisable to focus on the improvement of policies and measures to support the digital transformation of industry on the tasks of "massification" of the introduction of digital technologies by enterprises [15]. To do this, it is necessary to overcome such barriers as a lack of financial resources, a lack of competencies (both for managing digital transformation projects - for management, and for the use of digital technologies - for production and maintenance personnel), "patchwork" automation and digitalization carried out at earlier stages based on disparate IT solutions, mostly foreign, lack of practices and culture of working with data, information security risks (for some industries).

Sanctions introduced in the spring of 2022 may have a mixed effect on the Russian manufacturing industry. In the short term, the suspension of sales and updates of foreign software, a ban on the supply of foreign components, an increase in the cost of materials and equipment (including due to currency fluctuations), an increase in interest rates on loans, a decrease in effective demand and the volume of exports of manufactured goods will have a negative impact. In the medium and long term, sanctions pressure will become a critical incentive to diversify supply chains, search for new suppliers, and expand the range of import substitution [12]. Even before the last wave of sanctions, experts noted the presence of a "canopy" of excess employment in the economy — jobs with low productivity and, accordingly, wages, which could be considered a form of hidden unemployment [CMAKP, 2022]. However, against the backdrop of sanctions in the conditions of forced downtime of many industries, including due to the lack of imported components and components and (or) reduced sales (primarily export), the issue of excess personnel is even more acute. The introduction of automation systems, robotization may be delayed, as this exacerbates the problem of laying off workers. In the absence of access to updates and support for foreign software, the risks of failures of enterprise information systems will increase, and the impossibility of acquiring new licenses will slow down their scaling [14]. Software products that are used in industry are closely interconnected, it is quite difficult to replace only part of them and combine Russian software with foreign ones, so there is a need for a complete transition to our own compatible products. However, this does not seem realistic in many areas in the near future. In this regard, in the near future, IT teams in industrial enterprises will have to ensure the uninterrupted operation of existing solutions in the face of increasing cybersecurity threats associated with a lack of access to software updates [13]. A rather difficult situation has also arisen in microelectronics, since today it is impossible to ensure import independence along the entire front of the former import. Compared to software, the field of microelectronics requires incomparably greater investments, as well as human resources to create basic technologies. Russian developments and production of equipment can still be based mainly on imported components, microprocessors, semiconductor technologies, and computer-aided design systems. Within the framework of state support for the digital transformation of industry, it is advisable to provide, among other things, support for consortiums for the development of industrial and engineering software, concessional lending to import-substituting enterprises, changes in logistics schemes, and the most favorable conditions for business development, including in terms of tax regimes.

4 Conclusions

The pandemic, of course, gave a certain impetus to the development and implementation of digital technologies, acting as a catalyst for many trends that have long been discussed in the expert community (the spread of remote employment, the development of interaction in the digital environment, etc.). The coronavirus crisis, especially in its most acute phase, has placed citizens, businesses and the state in unprecedented conditions, forcing them to

acutely feel the importance of digital technologies, to fully appreciate the effects of their implementation, and immediately, and not gradually, as it would be under normal conditions. According to the authors, the accelerated adoption of digital technologies will continue in the future, and most intensively precisely in those areas that have experienced the most severe shocks from the sudden outbreak of COVID-19. Already today, certain long-term trends are visible, laid down or significantly strengthened over the past year since the beginning of the pandemic. Many of them have been noted above. In the current conditions, which are largely new, the state policy in the field of digital transformation should also undergo certain changes. First of all, it will be necessary to assess the practices that the organizations themselves formed during the pandemic as an adaptive response to the circumstances. For example, in many cases, telecommuting is regarded by companies as a relatively more efficient way of organizing activities, including due to savings in office rent and travel time to the place of work. Many of them plan to continue working remotely after the end of the pandemic, at least in part. Also among the promising areas for consolidating and further developing the experience of using digital technologies that have developed during the pandemic, one can note e-commerce, online education, telemedicine, and electronic public services. Such practices, if justified in terms of socio-economic effects, deserve to be encouraged and replicated. One of the fundamental conditions for digital development, including on the basis of artificial intelligence technologies, is the formation of a data market. It is necessary to focus on expanding the volume of open data, involving government data in circulation, and creating the necessary infrastructure. However, with the introduction of digital technologies, certain risks and public concerns regarding the safety of personal data and digital privacy are increasing. In this regard, one of the priority areas of state policy should be the formation of a regulatory legal framework that ensures the harmonious introduction of digital technologies, taking into account the interests of all major groups.

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