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# Digitalization as a Direction of the Industrial Policy of the Russian Federation

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**ABSTRACT**
The article considers the stages of digitalization of industrial technologies, gives their characteristics and features, as well as the degree of their influence on the development of enterprises in industrial sectors. The end result of the use of modern technology is a product, designed to solve problems of various complexity and meet a specific need. One of the directions of the development of modern production technologies is their digitalization. The paper also presents the main global trends in industrial development, identifies the interests of industrial enterprises in the process of digitalizing their activities, identifies the advantages of industrial enterprises when using digital technologies, and their transition from a traditional approach to a modern "advanced" approach to production. Differences between the traditional approach to production and the advanced one based on product integration were formed.
***Keywords:*** *digitalization of industry, digital technologies, industrial policy, digital economy, digitalization of production, explosion technologies, stages of technology development*

## 1. INTRODUCTION

Modern society is faced with a constant increase in the rate of update of knowledge and information, which inevitably leads to a change in all fields of human life. It is often difficult to keep track of such changes without having no idea about the key trends that determine our current and future reality. The industry is a key element of the state economy and a source of various material products that are so in-demand in our work and daily life.
The directions of modern industrial policy in Russia are to increase the volume of national production, create conditions for the development of scientific thought, implement the achievements of scientific and technological progress, improve the sectoral structure of the national economy, etc. [8].
The basic objectives of state policy in the field of industry are sustainable socio-economic development, independence and national security, growth in the well-being of citizens by increasing the competitiveness and efficiency of industrial production [9].
Each industry sector, within each individual country, is determined by its own, often unique, features and development trends. This is largely due to the social, scientific, and technological level of the country's development, state policy, and cultural specifics of the region, as well as many other factors, that determine the life of each country.
The following can be distinguished as the main world trends in the development of industry:
1. Growth in the complexity of production and manufactured products.
2. Digitalization of production and the use of digital twin technology.
3. Shifting the "center of gravity" to the design and development stage.
4. Reduction of time for making decisions (Time to Decision), implementation of projects (Time to Execution) and to put a solution on the market (Time to Market).
5. Mass customization of products.
The improvement of technologies leads to the fact, that technological processes in industrial productions and final products are becoming more complex and diversified. The demand for a maximum consideration of individual customer requirements is increasing. There is a need for mass customization and even personalization of products when the product is manufactured for a specific customer. One of the fundamental trends is the constant growth of the complexity of manufactured products and, as a consequence, the constant growth of the complexity of the production itself [10].

## 2. METHODOLOGY OF THE STUDY

In the work, a general scientific method of inquiry was used, such as analysis, on the basis of which the stages of development of digitalization of industrial technologies were studied, and with the help of a descriptive method, their characteristics was given. Based on the methods of induction and deduction, conclusions about the trends in the development of digitalization in the industry are drawn.
The study of the application of digital technologies in the management processes of industrial development involves the identification and analysis of a large number of various factors and features. At the same time, the use of digital technologies is due to their wide intersection and

 

interaction with many different scientific theories and disciplines. This is the theory of algorithms, the theory of computing devices and systems, informatics, economics, management, sociology, psychology, situation modeling, mathematical optimization methods, statistics, operations research, etc.

The work of domestic and foreign scientists, data of foreign researchers, materials of the socio-economic development of the constituent entities of the Russian Federation were used as an information base in the study. To achieve the objective of the study, the author relied on the provisions of scientific approaches: systemic, complex, technical and behavioral. The systemic and integrated approaches made it possible to generalize the results of previous studies and, first of all, to determine the time periods of the stages of development of digital technologies, and secondly, to justify their formalized characteristics. This makes it possible to introduce a new stage into the scientific use of the economy, associated with the implementation of digital technologies into the informatization of the Russian society.

Technical and computational approaches were used to study the infrastructure of digital technologies and digital devices. This allowed to systematize the properties of digital technologies and classify them as one of the most important competitive advantages, that ensure widespread penetration of digital technologies into industrial management processes and into the public fields of the economy.

The behavioral approach provided the authors with methods for studying the influence of digitalization of the economy, management, marketing, information support, production processes, and other fields of human activity on their attitude to the perception of information when using digital technologies. The amount of accumulated knowledge about the properties of information technologies and the characteristics of their application, including digital technologies and digital devices, allows to take a fresh look at the management of the development of spatial and industrial structures of regions in a competitive environment.

## 3. RESULTS

Speaking about the industry, it should be understood that its existence is conditioned by the needs of society and the tasks, the solution of which the created product is aimed at. In turn, the needs of society undergo constant changes over time, forcing the industry to develop and solve new more complex problems. It is strongly exemplified in the automobile transport, that is familiar to us, which successfully displaced animal-drawn vehicles from the everyday life of society. The first car with an internal combustion engine - a three-wheeled self-propelled carriage by Karl Benz, - certainly copes with the key task of land transport - the transportation of goods and passengers.

Today, society specifies a much larger set of requirements when choosing a car - comfort, in particular, the level of noise and vibration; power, dynamic characteristics, safety, efficiency, environmental friendliness, and many other requirements, that determine the quality of this system in the eyes of a single consumer. The modern world makes more stringent requirements for such products. The provision of all the above characteristics is associated with the solution of many difficult complex science-intensive and multidisciplinary problems, the solution of which requires more and more time, resources, and, most importantly, knowledge. For this reason, one of the fundamental trends is the constant growth of the complexity of the manufactured products and, as a consequence, the constant growth of the complexity of the production itself.

There are not many studies on how strongly this trend affects the economy of enterprises. For example, a study by the German consulting agency Roland Berger says, that annually German enterprises lose up to $30 billion due to the fact, that they cannot solve certain problems [1].

According to the McKinsey agency, up to 75% of heads of enterprises consider the lack of technical knowledge and skills among managers as a limiting barrier to enterprise development. Without understanding, what is happening in technologies and technics, as well as what trends in their development and use currently exist, it becomes almost impossible to effectively solve the emerging problems. For which reason, such companies spend more resources and time to achieve at least some results [2,3].

Technology is a set of techniques and methods of processing and reprocessing various media (material and non-material resources) in order to give them new characteristics, that increase their value in the eyes of the consumer.

When it comes to digital technologies, the so-called "Disruptive" or "Disruptive" technologies should not go unmentioned. This term is used to call technologies, the appearance, and implementation of which can significantly change the established market and turn the current situation in entire industries. Technology development model - 6D-architecture of development, describes six main stages of the formation of digital technology [4].

The first stage is directly associated with the "Digitalization" of technology - the implementation of new solutions, associated with the use of digital signals and digital information. As soon as something from the real world becomes digital, physical limitations disappear and new opportunities for interaction within the technology appear. The second stage is associated with the "Disparagement" of the new opportunities, provided by the digital display of the information, that previously had other forms of presentation. However, over time, the development of a new approach demonstrates an explosive increase in the efficiency of the technology under consideration. This stage is often called "Breakout".

The first three stages presented are the most important for achieving technological leadership within a particular industry. It is more important to replace these processes in time. In reality, the above stages proceed unnoticed both for the society and for the majority of enterprise managers. And accordingly, most competitors, without observing or

noticing them, fall into the trap that they can almost instantly lose the initiative and, as a result, their positions in the market.

Over time, technology becomes the appanage of an increasing number of industrial enterprises. Its variations and analogues appear, which invariably leads to its significant reduction of prices. This stage was named "Demonetisation".

The emergence of a universal device is also a reflection of one of the stages - "Dematerialization" when it comes to combining various technologies within one product.

The final stage is the "democratization" of technology, which implies its widespread distribution - its establishing becomes something familiar and ordinary.

Data, provided by various analytical agencies, are useful in terms of understanding the prospects of technologies and their level of readiness. In particular, the American research and consulting company Gartner is known for its analysis of the development of modern digital technologies. In its reports, this company uses a convenient graphical representation Hype Cycle, which reflects not only the current level of technology readiness but also the entire logic of development from the standpoint of the interaction of technology with society and industry [5].

Key areas of the Hype Cycle contains five stages:

– "Technology launching". This stage contains those technologies, that have just emerged and are just beginning to be discussed in certain circles of professionals and developers.

– "The peak of inflated expectations". There comes a time, when everyone is already talking about a new technological solution and the first enterprises appear, trying to test this technology on themselves in full in order to acquire a business advantage.

– "An abyss of disappointment." Naturally, after the first attempts to use the technology in practice, a more complete understanding of its real limitations is formed. It turns out, that the technology is full of weaknesses and flaws. Disappointment emerges, often reaching the point of being recognized as a failure.

– "Slope of enlightenment". Over time, the developers correct the identified errors, which leads to a new round of technology development, taking into account the idea of its real capabilities. The technology becomes more user-friendly, which leads to an increase in users and practical interest, but significantly less in comparison with the "peak".

– "Plateau of productivity". Technology won a seat in the market and became a convenient tool in a specific field.

If consider the value-added chain, it should be noted, that the production process itself is low-margin. The production process itself does not generate significant profit. Moreover, technologies at the production stage are not able to ensure the competitiveness of an industrial enterprise. In fact, all modern production moves towards building exactly the same architecture - "manless flexible automated production", that carries out high-performance production of high-quality products [11].

Consequently, if an enterprise seeks to be more competitive and provide sufficient profit, it should focus on added value.

On the one hand, it is possible to focus attention on the activities, associated with the manufactured products: distribution, marketing, sales and service maintenance. These processes are largely associated with technologies for analyzing and processing data, which allow to build a business process and predict emerging opportunities and risks. Often this means collecting a large amount of information not only about the state of the market, but also about the created products, about the use of various control and telemetry systems in order to collect reliable information about the processes.

The system of relations and dependencies, describing the behavior of a real object, as a rule, under normal operating conditions and contained in redundant Big Data, obtained at a real object, using industrial Internet technologies (IIoT) is called a digital shadow [6] More about data technologies will be discussed in subsequent lectures of this course.

On the other hand, an enterprise can focus on the design and digital modeling of products. The success of this stage depends on both modern digital technologies and competencies and experience in the field of this activity. The final characteristics and the level of product compliance with the market requirements are laid down at this stage. The ability to design complex science-intensive and high-tech products with guaranteed behavior throughout the entire life cycle ensures the enterprise leadership in the market of each industrial sector. For which reason, the most significant are those technologies, that provide the creation of so-called "digital twins".

A digital twin is a technology, a process of design, creation of globally competitive products, which is based on the development and application of a family of interconnected complex multidisciplinary mathematical models, described by spatial non-stationary nonlinear differential partial equations.

Mathematical models must have a high level of adequacy to the behavior in various operating conditions and real materials, and objects/systems/machines /structures, and those technological processes, by which real materials and real objects/goods/products are created.

The digital twin should ensure the difference between the results of virtual tests and physical/full-scale tests within ± 5% by hundreds of sensors [6], constantly replenished with data on the operation of a real object and display its functional state in real time. Such a model is created as a result of numerical modeling and optimization, it records all data on materials, construction features, operations performed, tests.

The digital twin makes allows to identify faults and carry out repairs in time, predict the state of the object, and make decisions about operating modes in the future. All this makes it possible to reduce the number of downtime and operating costs, to increase the efficiency of the equipment and systems used. In addition, production

cycles are shortened, which speeds up the process of introduction of products into the market.

The creation of a digital twin involves the development of a multi-level matrix of targets and resource limitations. Such a matrix can contain up to 60 thousand targets and requirements for the product and its components, as well as resource limitations (time, financial, technological, production, and others). This makes it possible to form a digital twin, which behaves in the same way as a real object at all stages of the life cycle, including the operation stage, with a high degree of adequacy to the real physical object.

And if the traditional high-tech industry is characterized by an administrative and command management system, low decision-making speed and lack of feedback, then the Digital industry is fundamentally different here. The core of the digital industry is a platform enterprise with its ecosystem and data-driven management, including through digital twins [11].

The combination of digital twin and digital shadow technologies is what provides a key competitive advantage and is currently changing the existing industry from a traditional approach to a modern "advanced".

Advanced and traditional approaches to the manufacturing process differ in a number of parameters:

- significant reduction in design time;
- significant reduction in time to introduce a product into the market;
- a significant reduction in the time to bring the product to readiness, will provide the necessary profit;
- reduction in the number of errors and redesign stages.

In the traditional approach, manufacturers have room for error. Since each time, releasing a new iteration of the product, more and more errors will be made, which will force to return to the stage of design, production and testing of prototypes. It is this cyclical repetition of these stages, that allows to identify all imperfections and create the most acceptable product.

However, it should be understood, that each successive iteration leads to a colossal increase in both the net cost and the time to put the product on the market.

Modern markets represent dynamic systems with rapidly changing needs and levels of demand for a particular product. It is vitally important for manufacturers to enter the market in the emerging “windows of opportunity” before they close.

In these conditions, the determining factor is the transition to new "advanced" models of the organization of the production process. In the modern approach, we are talking about the fact, that the involvement of technologies of virtual modeling, virtual testing and supercomputer design provides the ability to identify and eliminate all possible errors at the stage of product construction. The shift of the main labor intensity at this stage ensures the minimization of the number of iterations, associated with the re-release of prototypes.

Thus, costs and time for bringing the product to the market are significantly reduced [6].

## 4. RESULTS

The previously described trends in the high-tech industry are especially relevant in the context of changing consumption and demand pattern for high-tech products. Mass customization is replacing mass production [7].

If the previously successful model of the enterprise implied the release of an absolutely identical product of a small range in huge batches, today the market needs a wider variety of products to meet the needs of all groups of consumers. Modern consumers need a personalized set of product characteristics. The trend, associated with globalization and the naturally-determined mixture of ideas, cultures, tastes only contributes to the need for unique products. The modern industry is faced with a new challenge - how to meet the individual needs of consumers and at the same time avoid a significant increase in the net cost of such production. The digital industry is one way to answer this question.

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