Key end-to-end digital technologies in the ecosystem of the state's digital economy

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Abstract. The state is an active participant and an important stakeholder in the digital economy development program. The expected formation of the ecosystem of the digital economy will increase the efficiency of state functions performance, increase the degree of citizens' involvement in the life of society, and increase the competitiveness of the whole state. The effective implementation of government functions requires the fulfillment of the basic requirements for digital technologies in terms of the most effective implementation of the tasks. Based on these requirements, it is possible to identify the corresponding key end-to-end digital technologies, the inclusion of which in business processes will give maximum development.

1. Introduction

The digital economy is an economy based on digital, information and communication technologies. One of the tasks of the digital economy is to coordinate the interests of the state, society, business, citizens at every level of society [1].

At the international level, the digital economy provides interaction between business entities in such areas as the creation and use of new technologies and products, telecommunications services, e-business, e-commerce, e-markets, remote services [2]. The digital economy is a characteristic feature of the transition to the Industry 4.0 paradigm.

Russia has a program “Digital Economy of the Russian Federation” [3]. Three goals are declared in the Program: creation of an ecosystem of the digital economy of the Russian Federation, creation of necessary and sufficient conditions of an institutional and infrastructural nature, elimination of existing obstacles and restrictions for the creation and (or) development of high-tech businesses and increasing competitiveness in the global market of both individual sectors of the Russian Federation, as well as and the economy whole.

The program formulates such tasks as:

- creation of a system of legal regulation of the digital economy based on a flexible approach in each area, as well as the introduction of civil circulation based on digital technologies;
- creation of a global competitive infrastructure for the transmission, processing and storage of data, mainly based on domestic developments;
- ensuring the training of highly qualified personnel for the digital economy;
- ensuring information security based on domestic developments in the transfer, processing, and storage of data, which guarantees the protection of the interests of the individual, business and the state;
- creation of end-to-end digital technologies mainly based on domestic developments;
- introduction of digital technologies and platform solutions in the areas of public administration and provision of public services, including in the interests of the population and small and medium-sized businesses, including individual entrepreneurs;
transformation of priority sectors of the economy and social sphere, including healthcare, education, industry, agriculture, construction, urban economy, transport and energy infrastructure, financial services, through the introduction of digital technologies and platform solutions [3].

To set the pace in the global market, the state needs to take all into account the technological changes caused by the launch of the fourth (digital) industrial revolution. At the same time, the state can create conditions for the development of the digital economy: the legal framework, the required infrastructure (for example, ubiquitous high-speed Internet), the settlement of security issues, the policy of favoring the entry of Russian business into world markets, the training of highly qualified personnel [4]. In particular, the program "Digital Economy of the Russian Federation" involves the creation of a stable and secure information and telecommunications infrastructure for high-speed transmission, processing and storage of large amounts of data, available to all organizations and households; the use of mainly domestic software by government agencies, local governments and organizations.

Also, at the state level, standardization and appropriate regulatory regulation are needed, which will contribute to the implementation of a digital production system in Russia. Work is underway to develop the "4.0 RU" concept aimed at the integrated implementation of digital technologies at all stages and levels of industrial production and the creation of an appropriate digital production ecosystem [5].

Modern technologies allow in the near future to create an environment of a high-tech digital platform for public administration, which will ensure the minimization of the human factor and the accompanying corruption and errors, automate the collection of statistical, tax and other reports, and ensure decision-making based on an analysis of the real situation. The platform with open interfaces of machine-to-machine communication will allow, among other things, independent suppliers to expand the possibilities of interaction of citizens with the state by creating their own applications based on this platform (with mandatory certification for safety and legal compliance).

2. Methodology
As a research methodology, a qualitative method was used in the form of an analysis of the results of materials published in scientific literature on the issues of end-to-end digital technologies and state requirements for them. Interpretive methods for analyzing the results were used. The study used a systematic approach to conducting a literature review, which consists in studying the available scientific literature, assessing it and forming the research result.

3. Main part: description of the state functions
It is necessary to highlight the main functions of the state, clustered into external and internal. Within the framework of this work, the focus is on the possibility of using digital technologies in the implementation of the socio-economic functions of the state, which are classified as follows:

- legislative regulation;
- provision of public goods;
- ensuring economic growth;
- social policy implementation;
- stabilization of the economy.

The external functions of the state include:

- protection of borders, ensuring national security;
- development of cooperation;
- defending state interests in international relations;
- participation in solving global problems.

Internal functions include:

- Economic;
- Social;
- Political;
- Legal;
- Organizational;
- Cultural and educational;
The development of promising "end-to-end" digital technologies and projects for their implementation is one of the six federal projects of the national program "Digital Economy 2024". The main focus of the project is the creation of nine roadmaps in various areas of end-to-end digital technologies. This will make it possible to analyze existing modern technologies, identify the advantages and disadvantages of the latest end-to-end IT solutions and determine the trajectory of further development of economic sectors and the whole state.

The main end-to-end technologies are:

- Big data;
- New production technologies;
- Quantum technologies;
- Distributed ledger systems;
- Wireless technologies;
- Components of robotics and sensorics;
- Technologies of augmented and virtual reality;
- Artificial Intelligence;
- Industrial Internet.

Today "end-to-end" technologies are one of the guarantors of the successful implementation of the tasks of the digital economy. To make progress in the use of end-to-end digital technologies in enterprises of various industries, it is necessary to integrate technology into the business processes of companies. This requires an understanding of the basic characteristics and usage of each of their technologies. Here is a brief description of end-to-end digital technologies.

Big data means working (analysis and management) with information of a huge volume and composition, often updated and located in different sources, to increase operational efficiency, create new products and increase competitiveness [6].

New production technologies are a complex of multidisciplinary knowledge, advanced science-intensive technologies and a system of intellectual know-how, formed on the basis of the results of fundamental and applied scientific research, cross-industry transfer and the integration of advanced science-intensive technologies; new approaches, materials, methods and processes that are used for the design and production of globally competitive products or products that are in demand on the world market (machines, structures, assemblies, devices, installations, etc.). Examples include digital design and modeling, bionic design, additive and hybrid technologies (3D printing technologies) [7].

Quantum technologies include quantum computing, quantum communications, quantum sensors, and metrology. They allow to achieve significant progress in the areas of cybersecurity, artificial intelligence, and the creation of new materials [8].

Distributed ledger technology is a new approach to database creation, the key feature of which is the lack of a single control center. Each site composes and records registry updates independently of other sites. Unlike distributed databases, each participant in the distributed ledger system stores the entire history of changes and validates the addition of any changes to the system using a consensus algorithm, which mathematically guarantees that data falsification is not possible. No participant can change the data in the system in such a way that other participants do not know about it. Thanks to this, the data that is inside the distributed ledger system becomes trusted, and all changes are transparent. It is a blockchain technology that allows authenticating a person and concluding smart contracts [9].

Wireless communication technologies - a subclass of information technologies, are used to transfer information between two or more points at a distance, without requiring a wired connection. In such networks, radio waves of various ranges, infrared, optical or laser radiation act as a carrier of information. The main sub technologies are WAN (Wide Area Network); LPWAN (Low Power Wide Area Network); WLAN (Wireless Local Area Network); PAN (Personal Area Network); satellite communication technologies (STS), 5G, LTE [10].

The end-to-end digital technology "Components of Robotics and Sensing" covers the areas of development of automated technical systems and methods of their control, development of sensor systems and methods of processing sensory information, interaction of technical systems with each other and with humans. Robotics and sensorics are based on the methods of mechanics, electronics, mechatronics, and
other sciences. Robots are designed to replace a person when performing routine, dirty, hazardous work, as well as where high accuracy and repeatability is required, are already used in everyday life, in the field of human services, in medicine, in agriculture, etc. Human-machine interfaces are the basis of interaction with people, including promising interfaces based on the analysis of the electrical activity of the brain and muscles. Sensing includes methods for measuring physical quantities and methods for processing sensory information. Currently, drones are used, systems of sensitive sensors with copying of human sensory organs [11].

Virtual reality technology (VR) is a complex technology that allows you to immerse a person in an immersive virtual world using specialized devices (virtual reality helmets). Virtual reality provides complete immersion in the computer environment that surrounds the user and responds to his actions in a natural way. Virtual reality constructs a new artificial world transmitted to a person through his sensations: sight, hearing, touch and others. A person can interact with a three-dimensional, computerized environment as well as manipulate objects or perform specific tasks [12].

Augmented reality (AR) technology is a technology that allows you to integrate information with real world objects in the form of text, computer graphics, audio and other representations in real time. Information is presented to the user using a heads-up display, augmented reality glasses or helmets (HMD), or other form of human graphic projection (such as a smartphone or projection video mapping). Augmented reality technology enhances user interaction with the environment [13].

The use of artificial intelligence is supposed to implement new human capabilities in all spheres of activity, including for: freeing a person from monotonous work by automatically creating software; decision support; automation of hazardous types of work; support of communication between people. There are such basic sub technologies as computer vision; natural language processing; speech recognition and synthesis; recommendation systems and intelligent decision support systems; advanced methods and technologies in AI; neuroproteins; neurointerfaces, neurostimulation and neurotensin. Machine and deep learning, expert systems, virtual agents are already being used [14].

The Industrial Internet is a multi-level system that includes sensors and controllers installed on the units and assemblies of an industrial facility, means for transmitting the collected data and their visualization, analytical tools for interpreting the information received and other components. It assumes connection to the Internet of any non-household devices, equipment, sensors, sensors [15].

4. Results

Table 1 shows the ratio of the economic functions of the state with the above-mentioned "end-to-end" digital technologies, which allow solving the basic needs and tasks of the state.

| Economic functions       | Decomposition of economic functions                      | Key digital technologies                                           |
|--------------------------|----------------------------------------------------------|-------------------------------------------------------------------|
| Legislative regulation   | Protection of property rights                            | Distributed ledger systems, new manufacturing technologies, robots, wireless communication technologies |
|                          | Supporting competition                                   |                                                                 |
|                          | Small business support                                   |                                                                 |
|                          | Environmental policy                                     |                                                                 |
| Provision of public goods| Defense industry development                             | Robotics and sensing components, distributed ledger systems, quantum technologies, artificial intelligence, Big Data |
|                          | Provision of healthcare services                         |                                                                 |
|                          | Providing educational services                           |                                                                 |
|                          | Provision of services in the field of mass communications |                                                                 |
|                          | Development of knowledge-intensive industries             |                                                                 |
| Ensuring economic growth | Development of the agricultural sector                   | Industrial Internet of Things, new manufacturing technologies, big data, AR / VR technologies |
|                          | Infrastructure development                               |                                                                 |
| Social policy            | Regulation of labor relations                            | Big Data, wireless technology                                     |
|                          | Regulation of social payments                            |                                                                 |
|                          | Regulation of money circulation                          |                                                                 |
| Economic stabilization   | Income redistribution                                    | Artificial intelligence, big data, distributed ledger systems      |
|                          | Control over foreign economic activity                   |                                                                 |
From the functions of the state discussed above, the state's requirements for digital technologies arise, which make it possible to effectively implement its functions in the digital economy:

- minimization of the human factor;
- automation of reporting collection;
- creation of a unified cloud platform of public services;
- Information Security;
- the use of intelligent agents working on the principle of "smart contracts";
- introduction of an adaptation model for automated prioritization of budget expenditures;
- wide coverage of high-speed Internet;
- the use of big data infrastructure;
- use of nationally developed software;
- formation of an ecosystem of digital production 4.0.

It is possible to compare the state requirements for digital technologies with the corresponding end-to-end technologies of state regulation of the digital space of Russian business (Table 2):

| Requirements                                      | End-to-end technology                  |
|---------------------------------------------------|----------------------------------------|
| Minimization of the human factor                  | Artificial Intelligence                |
| Reporting automation                              | Artificial Intelligence                |
| Creation of a unified cloud platform of public services | Cloud technologies                  |
| Information Security                              | Quantum technology                     |
| Use of intelligent agents working on the principle of "smart contracts" | Distributed ledger systems           |
| Wide coverage of high-speed Internet              | Wireless technologies                  |
| Big Data infrastructure application               | Big Data                               |
| Formation of an ecosystem of digital production 4.0 | New production technologies           |

5. Conclusion
Allocation of key end-to-end digital technologies, the development of which is most important for certain state functions, allows to ensure the most efficient implementation of the tasks. The introduction of appropriate technologies into business processes will accelerate the creation of the ecosystem of the digital economy of the state as a whole.

Acknowledgment
The reported study was funded by RSCF according to the research project № 19-18-00452.

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