

Business process modeling within the digital economy development framework

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Abstract — The purpose of the study is to determine the significance of the digital economy at the present time and to consider the issues of transforming the traditional economic system into a digital system in modern Russian reality, within which solved the three tasks: a summary of national and foreign experience in the field of the concept and development of the digital economy was carried out, key competencies in the development of the digital economy were identified and problems and shortcomings in the Russian development methodology were found out, the transformation of business processes in the digital economy was analyzed, and business process models were proposed for various spheres of activities.

During the study the criteria for evaluating the system of the digital economy development were also identified as a controversial issue, but there are four main approaches have combined into a general scheme. The shortcomings of the Russian program for the development of the digital economy, which, in the opinion of the author, is lacking in the strict structuring of development directions, are identified. Also during the study the schemes of business process models transformation for enterprises in industry, agriculture and financial sphere, taking into account the modern achievements in the field of digital technologies have been proposed by the study.

Keywords — *digital economy, data analysis, business process modeling*

I. INTRODUCTION

Recently, the key direction of development not only for our country, but also for the world has been the transition to mass digitalization of the economy. Such a transition caused by a number of events associated primarily with the incredible pace of technological progress and the development of electronic devices and software.

The phenomenon of the development of the digital economy has been examined in a number of works by national and foreign scientists. It is need to highlight Brynjolfsson E., Kahin B. [4,5] among foreign authors, who made an attempt to study the digital economy in depth, identified the digital economy as a driving force for economic development, which gives the potential to make significant economic changes, influencing on various spheres of activity, level of labor and the very way of human life. A broad study of the digital economy and digitalization processes was found out by Dahlman S. et al [6], in which it is determined that the emergence of new technologies reorganizes existing economic processes, which leads to a change in the economic processes themselves, the reorganization of economic systems; This circumstance has a more positive effect on developing

countries. Manyika et al [15] approached the issue of digitalization from a practical point of view, determining that data flows are a serious component of the global economy, along with trade flows, and the influence of the digital economy is already more serious today than is commonly believed.

It should be noted, also, the works of national authors. Kupriyanovskiy V.P. et al. [29], consider the issues of finding patterns for projects of the digital economy and, concluding that each of the digital projects is characterized by a very precise and practically non-recurring set of conditions, they attempt to build a transformation model in the digital economy. Kudryavtsev G.I., Skobelev P.O. [28], summarizing Russian and foreign studies in the field of digital economy, formulate the key requirements for intelligent resource management systems of enterprises, solving the problem of modeling business processes for industrial enterprises. Approach to the study of the digital economy, proposed by Nesterenko E.A. and Goat A.S. [30], is to study the main vectors of the development of digital technologies with limiting the risks of digital security.

These works are only a small part of the whole set of works devoted to the concept, development and problems of the digital economy. Today it becomes obvious that the world economic system is shifting towards a new - digital economy, and, therefore, a more in-depth and detailed study of this process is needed.

The purpose of the study is to determine the significance of the digital economy at the present time and to consider the issues of transforming the traditional economic system into a digital system in modern Russian reality.

Based on the goal, we define the main tasks of the study:

- generalization of national and foreign experience in the field of concepts and directions of development of the digital economy;
- identification of key competencies for the development of the digital economy and identification of problems and shortcomings in the Russian development methodology;
- analysis of the transformation of business processes in the digital economy and the proposal of business process models for various fields of activity.

II. RESEARCH METHODOLOGY

1 Before we talk about the problems of the digital economy, it is necessary to clearly define the concept of "digital economy" itself.

A review of domestic and foreign literature on this issue revealed a wide variety of approaches to this concept.

It is need to note for beginning, that even the authorship of the term "digital economy" is still disputed. The most popular version is that this term was introduced into circulation by Nicholas Negroponte, in his work "Being digital", published in 1995, but for fairness, we note, despite the fact that the third part of the book is entirely devoted to certain elements of digitalization and its prospects Further, the term "digital economy" itself ("digital economy") is not found in the whole book even once.

Therefore, the majority of researchers consider Don Tapscott, whose work "Digital Economy" (in the Russian translation "Digital Society: pros and cons of the era of network intelligence ") came out just a year later than the above-mentioned "Being digital".

The author of the term itself meant a certain transition from the traditional economic model to a new one, taking into account the development of new technologies, innovations, and digitalization, which gave the name to the new economy model.

The concept of "digital economy" is very controversial, despite (and perhaps thanks to) the formation of an impressive layer of scientific literature describing this concept.

National authors demonstrate a wide variety of approaches. Kravchenko N.A. et al. [27] note that the digital economy has not yet received sufficient interpretation and is used synonymously with the concept of "digital society". Yudina T.N. notes [24] that this concept should be interpreted as the end result of the transformational effects of new information and communication technologies, which have a significant impact on all sectors of socio-economic activity. However, the vast majority of studies by national authors describe the digital economy in accordance with the program "Digital Economy of the Russian Federation" [31].

The most complete foreign approaches and evolution of the term "digital economy" were considered by R. Buht and R. Hicks in their work "Definition, Concept and Measurement of the Digital Economy" [23]. Based on 21 sources, they not only most fully disclose the concept of digital economy in the interpretation of various authors, but also draw conclusions about the impact of a particular period of technology development on approaches to understanding a term, in other words, studying its evolution.

Without going into the details of the research of R. Bukht and R. Hicks, as well as a number of domestic scientists, in the following term we will understand the economy, which is based on digital technologies, which does not contradict the basic concepts in this field.

Let us consider the experience of foreign and Russian scientists in the field of the development of the digital economy.

Foreign experience in the development of the digital economy is very diverse, both due to the uneven economic and technological development, and due to the different goal setting. In the study of E.N. Veduta and TN Dzhakubova [24] are presents the data for some countries that are considered advanced in the field of civilization. We summarize the main parameters in table 1.

TABLE 1. PURPOSE, BACKGROUND AND PROBLEMS OF THE DEVELOPMENT OF THE DIGITAL ECONOMY IN VARIOUS COUNTRIES

Country	Purpose	Prerequisites	Problems
Great Britain	World Leadership in Cyberspace Building	Leadership in global finance, has a competitive advantage in the field of artificial intelligence (AI)	Orientation only to distribution processes leads to the creation of a weakly stable system.
USA	Global Leadership in International Trade with Digital Technology	Existing leadership in world trade	A peculiar approach to confidential data, complicating the development of comprehensive relations with other countries
China	Increasing the quality of life due to the increase in production efficiency achieved by the use of digital technologies	Advances in the informational and communicational industry, in the production of electronic computing equipment for the aerospace industry and IT for medicine	Uneven economic development is exacerbated with the use of digital technology
Russia	The growth of the national economy due to a qualitative change in the structure and system of management of national economic assets	Enough scientific, human and technical potential in the field of software and application development	There is no analysis of the current state of the digital sector, there is no generalization of the experience of other countries, there is no formulation of competitive advantages in this area

As we can see from Table 1, there are quite a large number of differences in the development of the digital economy between both developed countries and Russia with them.

Note that the authors of the study, as well as a number of other authors, point to a list of shortcomings or inaccuracies in the design and development of digitalization programs.

One of the key shortcomings, according to many domestic and foreign scientists (for example, [24], [28], [29]) is the lack of an adequate system for assessing the growth and development of the digital economy, from which the problem of understanding the effectiveness of certain actions grows.

An overview of various assessment systems and indicators for the development of the digital economy is shown at the study of Semyachkov K.A. [32]. In general, it all comes down to four main criteria (table 2).

TABLE 2. CRITERIA FOR ASSESSING THE DEVELOPMENT OF THE DIGITAL ECONOMY

Criterion Type	The authors	Idea	Disadvantages
Employment	Bell D. [3], Drucker P. [8], Leadbeater C. [14]	Transition of workers from the traditional to the digital economy	Difficulty in assessing the quantity and quality of workers employed in the digital economy
Scale	Barron I. [2], Urry J. [19]	Globalization achieved through the development of network technologies	The ambiguity of the definition of networks and network technologies, the lack of strict evaluation criteria

Economy	Lane N. [13], Martin J. [16]	Growth of economic value of data and activities for their support	There is no adequate assessment of the impact of data on the final result, as well as ways to take into account the value of information.
ICT sector	Fuchs C. [10], Irawan T. [12], Mulgan G. [17]	The development of digital technology in market conditions	The contribution of various technologies to the economy varies significantly.

The data in Table 2 provide insights into the difficulties faced by researchers in their assessment of the digital economy.

2) Despite the sufficient diversity of approaches to the understanding and development of the digital economy, researchers around the world demonstrate a certain unanimity in the area of key competence of the digital economy, which, in their opinion, is data analysis.

Geissbauer R. et al [11] provides a diagram for the development of Industry 4.0 and related technologies which indicates that data analysis is the basis for the development of all digitalization processes: value chain integration, business modeling and user access, goods and services in the digital economy. This scheme is found in the study of R. Bay and R. Hicks [23]. Most studies do not call data analysis a key competency, but imply this, based on the logic of their research. For example, Anand M. [1] formulates three main trends in the development of modern digital enterprises based on data analytics. Aspects of data analysis in the modern digital economy are reflected in the OECD country report [18].

Other scientists, indirectly confirming these findings, focus on the fact that the development of Big Data technologies is the key to the further development of the digital economy. In the program of the European Commission Horizont 2020 it sounded that "Big Data is the fuel for the new digital economy" [9].

Obviously, it is the data analysis and Big Data that are the core competencies of the modern digital economy. However, the reasons for this state of affairs will be discussed further.

However, the reasons for this state of affairs will be discussed further. At the same time, the program proposed in the Russian reality [31] is currently subject to serious criticism for its lack of clarity, vagueness of the language and the general dispersion of the concept of "digital economy". In particular, with a constructive criticism of the program, Yakutin Yu.V. [35], which notes a number of shortcomings already at the stage of setting the goals of the program. In the sufficiency of the scientific substantiation of this program, Veduty Ye.N. and Dzhakubova T.N. [24], and Afanasenko I.D. express their agreement with this doubt. and Borisova V.V. [22].

At the same time, all the listed authors note both global progress in the development of digital technologies and the importance of the transition to a new type of economic relations based on a digital basis.

3) Given the differences in approaches, methods and means of evaluating the digital economy, taking into account the mentioned disadvantages and problems of the national

development program in this area, it becomes obvious that the time has not come for specific recommendations. Nevertheless, the transition to a digital economy should be carried out gradually and everywhere, starting from the lower levels, which will become a kind of trigger for the further development of the economy as a whole and its digital part in particular. However, the transition process raises a number of difficulties and questions. At the same time, it should be noted that a number of researchers attempted to solve this problem at different times and by different methods.

In the works of Kostyakov S. [26] reviewed the experience of a number of companies that have transformed their business models. In particular, they study the experience of John Deer, who proposed five steps to transform an agricultural enterprise as a result of a change in the business ecosystem, and Home Depot, which itself forms its own business ecosystem, establishing connections with all possible partners and competitors in its industry. Kudryavtsev G.I., Skobelev P.O. [28] studied the comparative characteristics of traditional enterprises and enterprises of a new type in the context of management functions and formulated ways of reforming enterprises of the domestic defense industry. Kovalchuk Yu.A., Stepnov I.M. [25] based on the fundamental analysis of the development trends of the world and national economies, they developed a model for transforming a modern industrial enterprise as a system.

Combining the accumulated Russian and foreign experience, V. Kupriyanovsky et al. [29], based on almost 30 examples of successful transformation in various fields of activity (construction, energy, trade, etc.) created a holistic model of digital transformation of businesses, shown in Figure 1.



Fig. 1 Holistic model of business transformation [29]

Also a strategy for planning the use of an integral model of digital business transformation during its implementation is proposed.

All these studies create a significant basis for the development of business process models for enterprises of various fields of activity.

III. RESULTS OF THE RESEARCH

1) Taking into account the above researches, the differences in goals and prerequisites, let us display the basic concept of the digital economy in the form of Ishikawa's scheme, using all the above systems for its assessment (Figure 2).

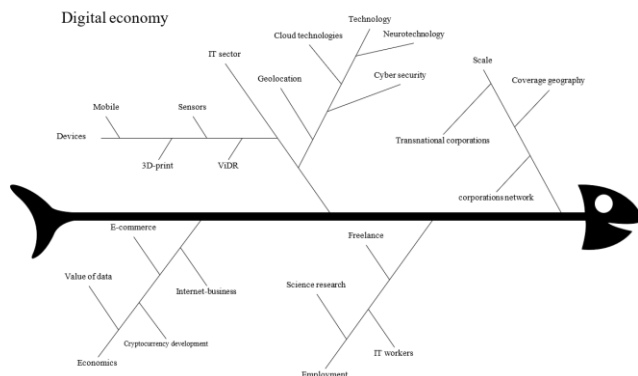


Fig. 2. Digital economy evaluation concept

Thus, the schematic concept reflects all the main approaches to the digital economy, and can be quite easily refined in the event of the emergence of new elements attributable to the digital economy.

2) Let ask ourselves why data analysis and why Big Data is the key aspect of the development of the digital economy today.

Regarding data analysis, everything is quite simple: The digital economy is an economy of data; it is the growing role of data that led to its formation. In line with this, the problems of data analysis are beginning to come to the fore in new digital activities.

For clarity, let us leave the interaction matrix, in the columns of which we indicate the main operations necessary to perform when working with data, and in the rows - the main directions of development of the digital economy in the world.

TABLE 3. INTERACTION MATRIX

	Collect ion	Analy sis	Storage	Broadcas t	Application
Big data		+	+	+	+
Cognitive technology		+			+
Neurotechnology		+	+		+
Artificial Intelligence		+			
Distributed Registry Systems	+	+	+		
Quantum technologies		+	+	+	
The Internet of things	+	+		+	
Cloud technologies		+	+	+	

As can be seen from table 3, data analysis combines all promising technologies of the digital economy.

The second question is related to the importance of Big Data in modern conditions. Given the rate of database replenishment and their volume, it becomes obvious that all data analysis in the very near future can be attributed to Big Data technologies.

The significance of Big Data is apparent now. According to the report of the analytical firm IDC "Data Age 2025", by 2025 the volume of all data worldwide will be 163 zettabyte [7]. Data growth occurs exponentially, which makes it necessary in the first place to develop methods and means of working with a large amount of information.

Figure 3 shows the growth in world data in annual terms.

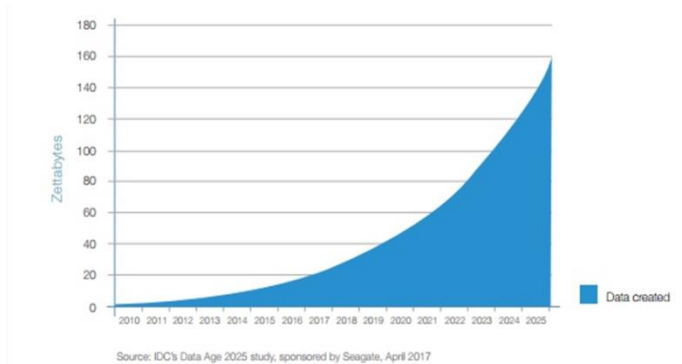


Fig. 3. Annual growth in world data [7]

Thus, the obvious increase in the volume of world data forces researchers to develop, first and foremost, Big Data methods and tools.

DISCUSSION OF RESULTS

The key disadvantage of the Russian program, in our opinion, is the weak structured development directions, which is quite different from world practice. This point includes in combining the various aspects of the digital economy into a coherent whole. It is necessary to list the main directions of the program, for visual indication of their shortcomings:

- 1) Big Data;
- 2) neurotechnology and artificial intelligence;
- 3) distributed registry systems;
- 4) quantum technologies;
- 5) new production technologies;
- 6) industrial internet;
- 7) components of robotics and sensorics;
- 8) wireless technology.

It is obvious here that 2, 4, 5 and 8 points, and also partially points 1 and 3, are related to development technologies, respectively, and should be considered within the framework of the development of technologies, which, in turn, should be provided with fundamental scientific research and applied developments. in specific areas. Items 6, 7, partially, 3 and 8 should be considered within the framework of devices, that is, to solve the problems of industrial production, using the means of reengineering. Regarding the implementation of paragraph 1, there is a need to develop completely new approaches based on a fundamental analysis of database management methods and tools, using both new devices and new technologies, methods of evolutionary modeling, machine learning and mathematical statistics, especially in the matter of data distribution [33] because working with Big Data today is one of the most complex and hard-to-implement programs.

Since there are no practical recommendations for specific business entities within the framework of the program [31], let us make an attempt to model digital business processes over time.

To begin with, let's display the business model for creating a new production taking into account the product life cycle (Figure 4).

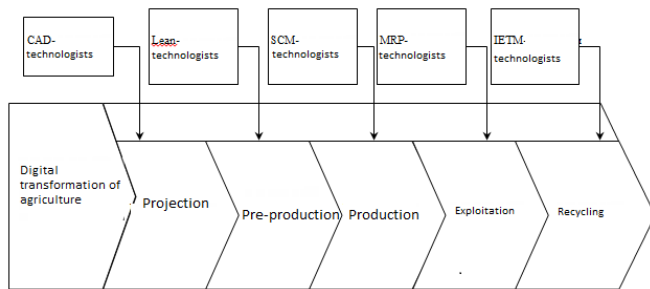


Fig. 4. Model of digital transformation of industrial production business process

According to Figure 4, industrial production should be based on each stage of the product life cycle. At each of the stages there is the possibility of applying various modern digital technologies, including the design, production, operation and utilization of industrial products management.

One of the main areas of digitalization of the industry is now becoming Lean-technologies that implement the concept of lean manufacturing that meets all the requirements of the digital economy. Among the tools Lean-technology is such a highlight as 5S, Kaizen and Value Stream Mapping [20].

Figure 5 shows the model of digital transformation of business processes implemented in crop production enterprises.

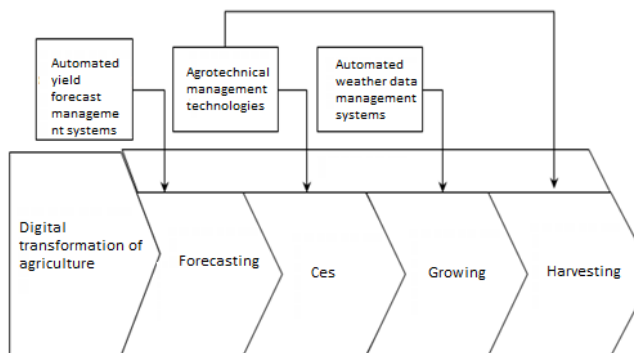


Fig. 5. Model of digital transformation of agricultural business process

Similarly, it can be noted that this model has quite similarities with the previous one, but it has a slightly smaller set of systems specified.

Automated yield forecasting and weather data management systems are being developed everywhere in relatively small research institutes, and even some farms. Note that the assessment and forecasting of yields (as well as weather factors) should be based on a qualitative statistical analysis.

Obviously, the most promising, and at the same time, complex process is the digitization of the available agricultural machinery, although a number of foreign enterprises are already developing prototypes of fully automated agricultural machines.

Let us turn to the business process model of a financial enterprise, which deals with the evaluation of proposed investment projects (Figure 6).

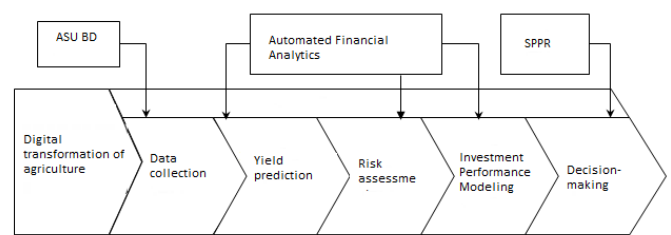


Fig. 6. Digital Transformation Model of an Investment Project Business Process

Making investment decisions can also be subordinated to the process of digitalization, especially since a great variety of different programs and products have now appeared that help in conducting financial or technical analysis (in the case of portfolio investments); In addition, the emergence and wide distribution of trading robots can be noted, although their effectiveness remains highly questionable.

This circumstance is explained not only by the growing interest in investment activities and, as a result, the stimulation of supply by demand, but also by the general availability of digital technologies in general. Moreover, there is a well-known relationship between investment and digitalization, since one affects the other and vice versa [21].

IV. CONCLUSIONS

A review of the literature showed a fairly wide variety of approaches to the definition of the digital economy and the directions of its development in different countries. Nevertheless, there is some general understanding of it as an economy based on digital technology. The criteria for evaluating the development of the digital economy also remain a controversial issue, but there are four main approaches that, within the framework of this article, were combined into a general scheme.

The fundamental concept of the digital economy is data analysis, and the main direction of development. At the same time, Big Data methods and technologies are used. The reasons for the first one lie in the fact that any direction of the digital economy involves analyzing data, and the second one - in the incredibly recent growth of data volumes, and problems with their analysis and adaptation to the needs of modern life. Also the shortcomings of the Russian program for the development of the digital economy, which, in the author's opinion, consists in the absence of a strict structuring of development directions, are identified.

The question of transforming the economy under new digital realities has been asked since they began to talk about these realities. Nevertheless, all attempts to bring the traditional economy to a digital one are currently fragmented and do not meet modern requirements. The study proposes a scheme for transforming models of business processes for enterprises in industry, agriculture and the financial sector, taking into account modern achievements in digital technologies.

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