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DIRECTIONS OF DIGITAL TRANSFORMATION OF THE AGRARIAN SECTOR OF RUSSIA

Nadezhda P. Brozgunova (a)*, Marina N. Guseva (b), Victoriya V. Krutikova (c), Natalya V. Melekhova (d)
*Corresponding author

(a) Michurinsk State Agrarian University, 101, Internatsionalnaya, Michurinsk, 393760, Russia, nadyazhm@mail.ru
(b) Michurinsk State Agrarian University, 101, Internatsionalnaya, Michurinsk, 393760, Russia, mnk68@yandex.ru
(c) Michurinsk State Agrarian University, 101, Internatsionalnaya, Michurinsk, 393760, Russia, tokareva-vik@yandex.ru
(d) Michurinsk State Agrarian University, 101, Internatsionalnaya, Michurinsk, 393760, Russia, kaf_in_mgau@mail.ru

Abstract

Currently, digitalization processes affect all sectors of the economy of modern Russia. Digital transformation of enterprises in general, and approaches to business management in particular, is one of the key success factors today. The issues of transition to digital technologies are considered at the intersection of economic and engineering thought, which significantly complicates the approaches to the study of these phenomena. It is necessary both to understand by what means and methods to carry out digital transformation, and to identify indicators of economic effect. In different spheres of the economy, these processes are rather heterogeneous. The agro-industrial complex of Russia is not high-tech and the processes of digitalization of the industry are currently at an early stage. Nevertheless, there is potential for digitalization in various sectors of the agro-industrial complex. The article discusses the main directions of digitalization of the agrarian complex. At the initial stage of digitalization of the agro-industrial complex, the use of information technology and digital methods in agriculture was mainly limited to the use of hardware and software for performing a number of management functions, accounting operations, drawing up financial and other types of reporting to government agencies. Whereas at present, modern breakthrough information technologies are being used more and more in the agricultural sector. The article also reveals the content of the main vectors of digital development in the agricultural sector, associated with the use of autonomous systems, the Internet of Things, big data analytics, artificial intelligence, robotics and cloud technologies.

Keywords: Agro-industrial complex, autonomous systems, digitalization, IT trends, information technology, Internet of things

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1. Introduction

The agro-industrial complex of Russia occupies an important place in the development of the country, ensuring food security. The development of the agro-industrial complex is not only a solution to production problems, it is the creation of new jobs, an increase in income, and the quality of life of millions of people. It is necessary to ensure high rates in the development of infrastructure, the social sphere of the village, including the systems of health care, education, culture, and the solution of housing problems of the villagers. We need modern, safe roads and engineering networks and, of course, the development of digital infrastructure, which is in demand by both citizens and businesses (Akhmetshina et al., 2019; Putin, 2020; Serbulova et al., 2019).

Currently, the processes of transition from traditional methods of management to new ones based on the use of analysis of large amounts of digital data are observed in all spheres of the Russian economy. These processes do not proceed evenly, the indicators of the intensity of the transition to digital technologies in different sectors of the country's economy are different. The agricultural sector lags behind in these transformations, but the vector for the development of digitalization is outlined.

Agribusiness in Russia, over the past few years, has reached a certain stage of development, at which there is an increase in investment in this sector of the economy, as well as an increase in the level of competition among agricultural producers, which is an important condition for the transition to digital production methods (Kivarina et al., 2021; Panov et al., 2019).

2. Problem Statement

Within the framework of the National Program "Digital Economy of the Russian Federation", key goals have been outlined: to make the Internet accessible to everyone; to cover the largest cities with 5G communication; to protect the information of citizens, businesses and the state; to increase the efficiency of the main sectors of the economy; to train personnel to work in the digital environment; to increase the share of the expenditures for developing the digital economy in the country's GDP by 3 times (National Program…, 2021). Thus, one of the main goals of digitalization is to improve the efficiency of the main industries. Therefore, it is necessary to analyze the main trends in the transition to digital technologies in the agro-industrial complex in order to identify trends in the main directions.

At the end of each year, a large number of forecasts from analytical companies appear regarding what technologies will be in demand in the next year. CNews Analytics agency presents the following data from a traditional survey among its readers regarding IT trends in 2021. The technology rating was calculated as the percentage of votes of CNews respondents who indicated it as one of the most demanded in general, and in a specific industry and in the real sector, respectively (Fecke et al., 2018; Rijswijk et al., 2019).

From the analytical data, it becomes clear that the directions of digital transformation of the agro-industrial complex are somewhat different from the general trend and are presented in Table 01 (CNews: IT Trends, 2021).

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Table 1. Rating "IT Trends 2021": the most demanded technologies

	In general	Agriculture	Real sector
Big data analytics	82	54	65
Artificial Intelligence	69	45	53
Cloud solutions	79	38	47
Internet of things	63	57	57
5G networks	33	19	25
Autonomous systems	29	64	65
Virtual and Augmented Reality	33	15	25
Digital twins	38	17	35
Blockchain	19	5	10
Peripheral Computing	11	12	16
Quantum technology	5	5	6

3. Research Questions

In accordance with this, the following issues are considered in the work:

– Use of autonomous systems (drones, robots, unmanned vehicles, etc.) in the agro-industrial sector;
– implementation of the "Internet of Things" technology in agricultural production;
– application of big data analysis and artificial intelligence in the agricultural sector;
– the possibility of switching to cloud technologies for agricultural enterprises.

4. Purpose of the Study

The purpose of the work is to study the main trends and directions of the transition to digital technologies in agriculture, based on the conclusions of analytical agencies, taking into account the specific features of the agro-industrial sector.

5. Research Methods

The research materials were the data of reports of the world news agencies in the field of IT sphere, as well as the main intermediate results of the National Program "Digital Economy of the Russian Federation" and the Departmental project "Digital Agriculture". The study was carried out on the basis of a systematic approach using economic and statistical, monographic (methods of analysis, comparison and generalization of the practical experience of agricultural enterprises) and abstract-logical methods.

6. Findings

In the agro-industrial complex, the volume and quality of the use of modern IT technologies, including systems for collecting, storing and processing data, is growing. Data from satellites, from sensors, from operational and transactional systems are increasingly being implemented in the management of agricultural enterprises. At the same time, both the volume of data and the need for their high-quality processing and reliable conclusions, which can be relied on when making decisions, increase significantly.

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The introduction of modern IT technologies in the agro-industrial complex is currently going on quite intensively. The volume of the Russian market of information and computer technologies in agriculture in 2019 reached 360 billion rubles; according to the Ministry of Agriculture of the Russian Federation. According to the ministry's forecasts, this figure will increase by at least 5 times by 2026 (Ministry of Agriculture of the Russian Federation, 2021). This means that a new investment segment AgTech is being formed, and digital production technologies will be used on each farm in the foreseeable future.

AgTech is a consistent ecosystem that spans the entire agribusiness value chain. This system is at the intersection of biology, agronomy, plant and animal science, and the introduction of digitalization processes served as a real driver and laid the foundation for the construction of the foundation for the future development of IT technologies in agriculture (AgTech - digital technologies in agriculture, 2021).

The merger of technologies can make AgTech a much more profitable investment compared to traditional investments in agricultural research.

The long value chain of agricultural products and the large number of unsolved problems in the industry that can be solved with the help of IT and automation are among the main reasons for the investment attractiveness of the industry.

The priority direction of digitalization of the agro-industrial complex in the near future is the introduction of autonomous systems. Currently, drones or unmanned aerial vehicles (UAVs) are already widely used in agriculture. Their use is mainly aimed at monitoring the ecological state of agricultural land, based on taking samples of air, water, soil and other indicators. Unmanned technologies are also an effective means of providing research on the functioning of land infrastructure facilities. Thanks to the UAV, aerial survey data are actively used for BigData analysis in agriculture.

Extensive use of hardware and GPS navigation, allow you to measure and record sensor readings of agricultural machinery. The GPS-based parallel driving system is technically and cost effective for modern agricultural machinery. The use of parallel driving systems in conjunction with wide-cut units is especially effective, and satellite navigation systems allows building optimal trajectories in order to minimize overlap and gaps between adjacent stints.

Thus, the introduction of autonomous systems in the agro-industrial complex and the data obtained on the basis of their application, the task of creating a unified database on the composition and condition of farmland, the use of various technologies of soil cultivation, growing different varieties of plants, methods of using crop rotations, etc.

Another area of digital transformation of the agro-industrial complex is associated with the Internet of Things. Within the framework of this technology, the use of AIoT platforms and AIoT applications may become promising. Today, the concept of edge computing is gaining popularity: data processing is gradually moving to the edge, to IoT devices that directly collect this data. The next step towards more efficient information analysis without delays is the use of artificial intelligence (AI). Therefore, the emergence of a hybrid of the Internet of Things and AI, called AIoT (AI + IoT), has become quite logical. The IoT platform plays the role of an intermediary: devices and solution components can transmit data in a wide range of formats using various communication protocols. The platform ensures the joint operation

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of all devices and system elements, makes it possible to develop custom applications and services (Microsoft Azure, 2021).

For the agricultural sector, AIoT solutions allow automating the entire cycle of agricultural operations for growing plants or animals (Khaiturina, et al., 2018; Shamshiri et al., 2018).

One of such solutions is the digital platform Digital Agro—digital services for agriculture, including all effective tools for crisis management of the economy. The priority line of activity of Digital Agro is the development and provision of technologies that allow ensuring a significant (up to 15%) cost reduction and (up to 20%) increase in the profitability of agricultural production.

Today the company offers the following software solutions for farmers:

- Digital platform “Agrosignal”;
- Assistant agronomist (helps to plan and control work in the fields);
- Open Agrarian University “Land of Knowledge”;
- Subsidies and Reporting;
- Adaptive farming system (Digital Agro - digital services for agriculture, 2021).

In recent years, work on the design of robotic devices has intensified in the agricultural sector. Robots in agricultural production are used to perform repetitive operations in the cultivation of crops and raising farm animals.

The following key areas of application of robots in the agro-industrial complex can be noted:

1) Unmanned tractors and aircraft;

2) Management of material resources;

3) Automated systems for growing crops;

4) Forest management, subsoil use;

5) Automated control systems for dairy farms.

Another important area of digitalization of the agro-industrial complex is analytics of large amounts of data (Big Data). Modern companies are constantly forced to compete, and data analysis becomes the main advantage in these processes. It is the very factor that helps to reduce the company's expenses, increase revenue, reduce the time for performing business processes (find out the weak point and optimize it), increase the efficiency of the company's business processes, and fulfill any other goals aimed at increasing the efficiency and effectiveness of the company's activities (Brozgunova, 2020).

The goal of any data analysis at any level is to identify patterns and use this knowledge to improve the quality of a product or the work of a company or department. Data analysis is necessary for agricultural enterprises in the following main areas: accounting and finance (Kuzmich, 2021), human resources (HR), marketing, advertising and promotion of products, administration and others.

Summarizing the data on the use of digital technologies in the agro-industrial sector, we can highlight some of their common characteristics.

Digital technologies used in agriculture have a number of significant features, namely:

- firstly, these are technical means with a software component, the functional purpose of which is aimed at implementing business processes for the production of basic types of agricultural products;

- secondly, these are software and hardware tools and digital platforms designed for the collection, processing and analysis of information resources of agricultural organizations, the formation of industry

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databases, and interaction with departmental structures;

- thirdly, these are digital systems for managing technical means, monitoring land resources, managing the life cycle of plants produced and raising farm animals.

Opportunities and limitations in the use of digital technologies in agriculture can be identified Table 02.

Table 2. SWOT Analysis of the Digital Transition of Agribusiness Enterprises

Strengths	Weaknesses
Increasing the efficiency of production of basic agricultural products at enterprises of various forms of ownership	Large financial costs for the introduction of digital technologies
Growth in labor productivity in agricultural enterprises with the introduction of digital technologies	The need for training, advanced training and retraining of employees of agricultural organizations
Raising awareness of all business processes in agricultural production, increasing the efficiency of management decisions	The complexity of the transition to digital platforms and analytical systems for processing large amounts of data, poor representation of their financial efficiency at the initial stage
Expansion of human capabilities in the workplace, the emergence of new professions and jobs	Introduction of additional functions for information processing personnel
Involvement of a new generation of human resources in the industry, by increasing the attractiveness of the agro-industrial complex	Resistance of individual workers, heads of peasant (farm) enterprises, heads of agricultural organizations to the transition to digital technologies
Opportunities	Threats
Creation of additional jobs in the high-tech sector, including in programming, administration, networking, cloud solutions and big data processing	The outlined lag of the agricultural industry during digital transformation
A significant increase in investment in the development of digital technologies in the agro-industrial complex based on the implementation of autonomous systems, digital platforms, software development, 5G network, cloud solutions, AI and machine learning, and the use of big data.	Low clarity of the consequences of the introduction of digital technologies and economic effects for the majority of agricultural organizations of all forms of ownership
Possible technological breakthroughs in agricultural production based on the use of digital technologies	Low qualification of personnel of agricultural organizations, opportunities for retraining are difficult to implement

7. Conclusion

Thus, the use of digital and IT technologies is increasingly penetrating all segments of agriculture. The agrarian complex of Russia cannot be classified as one of the most innovative industries, but nevertheless, the digital transformation of the agro-industrial complex and the planned technological breakthrough are one of the main trends in the industry for the coming years. The federal project "Digital Agriculture" notes that the introduction of IT technologies will reduce costs, reduce production risks, and also increase labor productivity in agriculture by half by 2024 (Ministry of Agriculture of the Russian Federation, 2021).

Agricultural production is becoming more and more high-tech every day: information comes from devices located in the field, on a farm, from sensors, agricultural machinery, weather stations, satellites and

drones. Data is accumulated in one place from different participants in production processes and an information field is formed, with the help of which the farmer can easily find errors in the application of agricultural technologies. Based on these data, the speed and quality of applied management decisions increases, risks decrease, and production profitability increases. This is one of the main goals of the digitalization of the agro-industrial complex.

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