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DIGITALIZATION OF AGRICULTURAL SECTOR: OUTLOOK IN RUSSIA

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Abstract

Agriculture is turning into a sector with an intensive flow of data; the data aggregate processed by modern programs provides information of a new quality allowing us to find patterns and make forecasts. The goal of digitalization is to maximize automation of all stages of production and optimize resource management based on decisions made by software tools and database management systems. The digital transformation of agriculture is part of the federal strategy, the purpose of which is to modernize and increase the efficiency of the industry, the introduction of digital technologies and platform solutions to ensure a technological breakthrough in the agricultural sector. The scenario involves the incremental development of digitalization of agriculture. The level of penetration of digitalization in agricultural production is analyzed, the prospects of the process are determined in the context of the tasks set by the government and the availability of developments by Russian companies in the field of digitalization of agriculture.

Keywords: Agribusiness, digitalization, technology, state programs, trends, prospects.

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1. Introduction

The level of agricultural production today is determined by the degree of intellectualization of production, the availability of modern technologies and automated technical equipment of a new generation along with appropriate information and instrumentation provision. The transition to advanced intelligent technologies is today the main vector for improving agricultural production in the world, which ensures increased production efficiency by increasing productivity and labor quality, optimizing production costs and reducing their losses, as well as improving the efficiency of logistics solutions (Buklagin, 2017).

According to the McKinsey Global Institute (MGI), up to 50 % of work operations in the world can be automated in the next 20 years. In scale, this process will be comparable to the industrial revolution of the 18th-19th centuries. If previously the availability of roads, water supply, electricity and other infrastructure was decisive for the manufacturer, now access to fast communications is extremely important for automating data collection, analyzing large amounts of information and making decisions quickly.

The modern model of technological development of the Russian Federation provides for the accelerated development and modernization of the Russian economy by replicating the basic innovations of the fifth and forced transition to the sixth technological order, the basis of which are nano-, bio-, information and telecommunication (digital) technologies.

2. Problem Statement

The level of penetration of digital technologies in agriculture in Russia as compared to the developed countries is relatively small and the introduction of advanced digital services is slow. According to the Ministry of Agriculture of Russia, there are only 5 IT specialists per 1,000 agricultural workers, investments in digital technologies are no more than 10 rubles / ha, while in the European Union (EU), these values are 25 IT specialists and 350-500 rubles / ha accordingly. Russia took the 23rd place in the Digital Society Index 2019 ranking of countries for the development of the digital society (Serbulova et al., 2019).

The research interest in digitalization of agriculture is growing annually, a significant number of works of domestic and foreign authors are devoted to various aspects that directly or indirectly solve the problems of the process, the aspects of state support, legal regulation are analyzed, the projects and experience of their implementation, problems and obstacles, deterrents, etc., are discussed (Boev et al., 2020; Butyrin & Butyrina, 2019; Guzueva et al., 2020; Ivanov, 2018; Khabarov & Volegzhanina, 2019; Ognivtsev, 2019; Panov et al., 2019; Semkin, 2019; Serbulova et al., 2019; Sokolova & Litvinenko, 2020)

3. Research Questions

In recent years, much attention has been paid to the development of the digital economy in general and digital agriculture in particular. The digital transformation of the agricultural sector is part of the federal strategy where the departmental project titled "Digital Agriculture" (within the framework of the "Digital Economy" national project) is being implemented, the purpose of which is to modernize and improve the efficiency of the industry, the introduction of digital technologies and platform solutions to ensure a technological breakthrough in the agricultural sector that will lead to a twofold increase in labor productivity by 2024. The resource support for the project is 152 billion rubles, 85 % of the project budget

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is a targeted state support to stimulate the implementation of projects (Departmental project called "Digital Agriculture", 2019; Digital transformation of agriculture in Russia, 2019; Marinchenko, 2019). But how much is the industry ready for this? Are the competencies of Russian companies sufficient to build the infrastructure of the digitalization process in the period designated by the government?

4. Purpose of the Study

The purpose of the study is to analyze the level of penetration of digitalization in agricultural production, to determine the prospects of the process in the framework of the tasks set by the government and the availability of competencies among Russian companies.

5. Research Methods

5.1. Research materials

The research materials were the departmental program titled "Digital Agriculture", scientific publications on the problems of digitalization of the agricultural sector, and data on Russian developments in the field of digitalization of agriculture.

5.2. Research Methods

The methods used were monographic, comparative and system analysis, idealization and mental modeling, as well as a logical approach.

5.3. Results

Russia ranks the 45th place in terms of information technology penetration into agriculture; only 10 % of arable land in this country are tilled using digital technology according to the Russian Ministry of Agriculture. According to estimates, only 13-15 % of Russian agricultural producers are able to engage in digitalization and commercialization of scientific and technological developments (Smart Farming, 2018).

The efficiency of domestic agriculture in Russia is noticeably inferior to the largest economies. According to expert forecasts, 25 % of the global economy will switch to the implementation of digitalization technologies by 2020. Smart farming / precision farming programs are available in dozens of countries. The pace of implementation of “artificial intelligence” technologies in the agricultural sector is growing by 22.5 % annually. According to Markets and Markets, the global market size will be $ 2.6 billion by 2025 (Marinchenko, 2019).

On the other hand, about a third of all food products in the world (940 billion US dollars annually) is lost or waste. Digitalization can reduce these losses by 25-30 %, increase the profit of agricultural enterprises and their attractiveness for investment, and also control 2/3 of the most important factors affecting productivity (Digitalization in agriculture: technological and economic barriers in Russia, 2018).

Digital data to be processed using modern principles of collection and processing are considered as one of the key assets of the industry. The national platform called “Digital Agriculture,” which is being integrated with platforms of related industries, will accumulate information, industry best practices and models, as well as provide access and data processing services, which will significantly speed up the process

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and achieve a synergistic effect. In the near future, the platform will become the basis for building an ecosystem of digital services and services in the agricultural sector (Ognivtsev, 2019).

The objective of the departmental project is the digital transformation of agriculture through the introduction of digital technologies and platform solutions to ensure a technological breakthrough in the agricultural sector and to achieve a two-fold increase in productivity at digital agricultural enterprises by 2024 (See Table 01 below).

Table 01. Target indicators of the departmental project titled "Digital Agriculture" Digital transformation of agriculture, 2019

Indicator	**Years**					
Share of data on agricultural resource facilities included in the "Digital Agriculture " digital platform, %:	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Agricultural land (of the total area of agricultural land)	50	75	90	100	100	100
Working and productive livestock (from the total number of livestock in the category)	25	35	50	75	90	100
Farm machinery (the total number of units)	45	60	75	90	100	100
Growth rate of labor productivity (for enterprises that have introduced digital agricultural solutions), %	105	125	150	175	190	200
Ratio investment in digital products and technology of the total investment, % Including that in domestic development, %	1 0.5	3 1.5	7 5	10 7	15 10	25 20
Share of SMART contracts with recipients of subsidies, %	5	25	50	75	100	100
Share of regions that have implemented planning based on the Digital Agriculture platform, %	0	6	29	59	100	100
Share of material costs in the cost of production (for enterprises that have introduced digital agricultural solutions), % of the cost	60	55	50	47	45	43
Share of specialists in the field of the digital economy, % (of the total number of specialists, on an accrual basis), %	10	15	20	30	40	50

The program dictates the need for an inclusive use of logistics transportation, stimulating domestic consumption, developing product exports and building platforms that provide end-to-end digital solutions for creating added value and ensuring the competitiveness of Russian business.

The scenario involves the step-by-step development of digitalization of domestic agriculture in production cycles. Given the "horizontal nature" of the transforming industry, this will ensure the creation of life-cycle chains for production and sale of products.

The introduction of digital economy technologies will provide economic effects and reduce costs by at least 23 % with an integrated approach according to the Analytical Center of the Ministry of Agriculture of Russia (Presentation of the Ministry of Agriculture of Russia, 2018).

The task of digital technology is the maximum automation of all stages of the production cycle in order to reduce losses and increase productivity, optimization, resource management based on decisions made as a result of processing BigData streams.

The solution package that allows automating the entire cycle of agricultural operations for growing plants or animals is an AIoT project that make it possible to automate the entire cycle of agricultural

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operations for growing plants or animals. Mandatory components of such solutions are: peripheral equipment (sensors, sensors); communication channels (satellite communications GPS / GLONASS, LPWAN, LTE, 3G, GPRS, GSM); AIoT platforms (web platforms for creating industry applications) and AIoT applications (applications for IT platforms, standalone applications for specific equipment).

The AIoT-application generates logic for solving tasks set, analyzes the received data streams and interacts with the user through the interface. Sometimes the AIoT platform and the AIoT application are one. The main application of AIoT platforms / applications is precision farming too.

The Internet of Things is beginning to play a big role in the digitalization of agriculture, that is a concept of a computer network of physical objects ("things") equipped with built-in technologies for interacting with each other or with the external environment considering the organization of such networks as a phenomenon that is able to rebuild economic and social processes excluding the need for human participation from a part of actions and operations.

The Business Insider estimates the IoT segment in agriculture at $ 43 million. According to Markets and Markets, the size of this market will amount to $ 2.6 billion by 2025.

The total economic effect from the transition of agriculture to business models based on IoT and digitalization may amount to more than 4.8 trillion rubles in annual terms or 5.6 % of Russia's GDP growth (compared to 2016), and a possible increase in the consumption of information technology may amount to 22 % (The Internet of Things in Agriculture, 2018).

When implementing IoT projects, an ecosystem of partners is formed, that is to say, an interaction system in which the benefits of cooperation prevail over competition. Participants create new products and introduce innovations that they could not create separately. The result is achieved for all participants in the process.

The IoT platform is a central element of the IoT ecosystem and integrated IoT projects with a high degree of automation, a large number of participants and connected devices. The IoT platform plays the role of an intermediary: it ensures the collaboration of all devices and system elements, makes it possible to develop user applications and services.

Rightech and Componenta JSC (kSense platform), Moscow, can be distinguished among domestic companies that provide services for the deployment on the IoT platform of the dedicated software that is able process data collected using sensors, Rigtech and kSense IoT platforms allow automating monitoring of vehicles and agricultural machinery, storage and processing of agricultural products, as well as monitoring of agricultural land and livestock management.

The Exact Farming company (Moscow) helps enterprises manage the yield and profitability of the fields using the Exact Farming online service / mobile application. The Smart4agro software product from Alan IT company (Yaroslavl Region) is a cloud geoinformation and analytical service to support management decision-making in the field of agriculture, control, analysis and forecasting of farmland.

Strizh Telematics (STRIZh IoT platform, Moscow), LEYS LLC (Every Net Core Network platform and LoRaWAN protocol tracking equipment in LPWAN, St. Petersburg) are also involved in the Industrial IoT projects (Smart Farming: An Overview of Leading Manufacturers and Technologies, 2018).

Productive Technological Systems (PTS LLC), Moscow, presents the ThingWorx IoT solutions platform on the domestic software market, which includes tools and technologies that allow enterprises to

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quickly develop and deploy powerful applications for the industrial Internet of Things and augmented reality environments (AR). The basis of the information model of the ThingWorx platform is an "intelligent object" multifunctional scalable data structure with the flexible modular assembly architecture.

The ThingWorx platform usage mode is provided both in the "traditional" client-server form and in the "remote access" option as a cloud solution.

The core of the ThingWorx platform includes a database on the information model of production processes and "smart" objects for which digital transformation is performed based on the supplied versatile templates of objects, sensors, processes, and interfaces. The Thing Worx Connectivity Server is used to communicate with controlled, intelligent, autonomous sensor devices. Work with the BigData streams and the necessary analytics for this is performed by the Thing Worx Analytics server, which contains six basic certified machine learning algorithms, that are elements of artificial intelligence. Even with this basic configuration, deploying analytics on the Thing Worx platform to work with the data flow coming from external connected smart devices allows switching to the real solution of prognostic tasks and building an expandable and adjustable knowledge base.

The Thing Worx Utilities server enables including the solution of such tasks, as asset management, risk management, task flow management and role management, and integration with management modules of external systems.

The Thing Worx Studio module is used to develop augmented reality (AR) applications that could be used as digital counterparts, virtual simulators, assistants in complex operations, etc.

The described modular, scalable, customizable Thing Worx platform structure allows performing digital transformation projects of various dimensions and complexity of any agricultural industry (Digitalization is the most effective way to reduce costs, 2018).

The Cyber village 4.0 integration technological platform for agricultural production management from Cyber village (Moscow) is a strategic and analytical system for agricultural management and is designed to automate the collection and analysis of agricultural performance indicators in the framework of an agricultural holding and allows collecting the holding units' territorial information via the Internet and generating general reporting taking into account the peculiarities of regional policy (UAV: unmanned aerial vehicle (drone), 2019).

A new Russian development is the ANT information system (Moscow) created on the Geo Look platform. It is a turnkey cloud product that provides access to satellite maps and services, weather reports, navigation tools, reference materials, monitoring and can upload its own data to the system. Cloud services can integrate a huge amount of data: from farmland maps, through enterprise structure to regularly updated weather reports. These platforms store information about all technological operations, keep field certificates, calculate the amount of seeds and fertilizers, draw up reports, analyze risks and predict production processes. In addition, the platform helps to optimize workflow, perform calculations and conduct analytics; the service has a built-in search system for searching data, documents and photos according to specified criteria.

Bashkir-Agroinvest LLC, which grows crops on a field area of 89,000 hectares, tentatively estimated the increase in yield from the introduction of ANT by 15 % due to the tightening of control over compliance with agricultural technologies and reducing losses during harvesting. In addition, direct costs are expected

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to decrease by 7-10 % due to tighter control over the amount of agricultural operations to be performed, as well as the suppression of misuse of equipment and the consumption of inventory (Marinchenko et al., 2018; The concept of "Scientific and technological development of digital agriculture. Digital Agriculture", 2018).

The shift of technology towards the Internet of Things has determined switching telecom operators from the concept of traditional telecom operators to the concept of digital transformation centers in the Agriculture 4.0 format. For example, MegaFon has strategically focused on Big Data, the Internet of Things, while offering them to manufacturers in an affordable way.

6. Findings

Digitalization processes in agriculture and the Russian economy as a whole will involve an increasing number of value chain creation participants in the development of joint IoT solutions. A unique property of the Internet of Things and aggregated BigData processing is that the more data is collected and processed by modern software tools, the more "smart" the system becomes and the more valuable is the information generated as a result of processing: ready-made mathematical models of production and marketing processes that allow planning amounts, quality, and profitability in geographic and temporal dimensions.

From the point of view of the process logic, the process is being transformed from monitoring system software to ready-made IoT platform solutions along with implemented means of intellectual learning, device interaction algorithms, big data analytics, augmented reality, digital twins and other elements of Industry 4.0. The experience of Russian companies allows talking about the resource sufficiency for large-scale planned work, while the competencies allow quickly responding and providing solutions to the demands of agricultural producers.

7. Conclusion

The main global trend in the upgrading of production is the introduction of digital technology. In Russia, the digital transformation of the agricultural sector is an object of increased attention, however, the introduction of technology is slow. One reason for this is the lack of specialists. In order to accelerate digitalization, the departmental project called "Digital Agriculture" is being implemented. The project objectives include the growth of agricultural exports, an increase in the industry's contribution to GDP, an increase in labor efficiency and productivity, a reduction in production costs, the creation of new high-tech and knowledge-intensive products and services, as well as the preparation of the necessary competencies among specialists.

The observed progress in the field of the Internet of Things, BigData analysis, cloud computing and artificial intelligence will make it possible to obtain grandiose innovations and transform fundamentally agricultural production and public administration, ultimately contributing to an improvement in people's lives. To implement the concept of digital development, it is necessary to create a center of competencies, which should contribute to the implementation of the departmental project titled "Digital Agriculture".

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