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Digital Transformation of the Agro-Industrial Sector of Russia: Challenges and Opportunities

Konstantin Kalashnikov
Department of Marketing, Economics of Enterprises and Organizations
Saratov socio-economic institute (branch) of Plekhanov Russian University of Economics
Saratov, Russia
ORCID: 0000-0003-1301-0155

Mikhail Zhadan
Department of Marketing, Economics of Enterprises and Organizations
Saratov socio-economic institute (branch) of Plekhanov Russian University of Economics
Saratov, Russia
michael.zhadan@gmail.com

Natalia Baryshnikova
Department of Economics
Saratov State Law Academy
Saratov, Russia
nvas_2000@mail.ru

Sergei Saninsky
Department of Marketing, Economics of Enterprises and Organizations
Saratov socio-economic institute (branch) of Plekhanov Russian University of Economics
Saratov, Russia
ORCID: 0000-0002-7684-5515

***Abstract*—The relevance of this research is due to the required digital modernization of agro-industial complex (AIC) that will significantly increase production efficiency, product quality and competitiveness, as well as labor productivity in comparison with traditional economy management. The objective of this paper was the analysis of key factors of digitalization and overview of the results of the implementation of digital technologies by Russian enterprises in order to define the directions of innovative changes in production process at AIC enterprises. Achieving the goal of this study is based on a comparative analysis of digitalization factors proposed by experts in this field, in order to find the key ones contributing to the formation of an innovative infrastructure and to determine the conditions and results of digitalization at agricultural enterprises. Methodological framework of this study includes the combination of comparative and statistical analysis. A comparative analysis of digitalization factors was performed; key areas of innovative development of the agricultural sector were identified; the overview of the implementation of digitalization technologies by Russian enterprises was given; the impact of digitalization on the development of enterprises and national economy was estimated; solutions were proposed that were required to stimulate the innovative changes in production process at agricultural enterprises. Digital transformation of Russian agriculture is just starting to gain pace, so it is impossible to say what the industry will look like, for example, in 15–20 years. At the moment, it is obvious that the effect of the digital transformation of the industry is "piecewise", fragmented. Large companies definitely have greater digitalization potential, and yet, focus on the development of Russian agriculture based on digital technologies has no alternative variant.**

Keywords—digitalization, digital technologies, agro-industrial enterprises, agro-industrial sector of Russia, innovative infrastructure, innovative development, agricultural sector.

I. Introduction

Under increasing competition in agricultural market, increasing external risks and threats for manufacturers, and a transforming food consumption model, many problems in agro-industrial sector can be solved on the basis of a transition to digital agriculture, i.e. precision farming and smart livestock breeding which involve the high use of digital technologies in key business processes.

The historical development of world agricultural production is characterized by a series of scientific and technological revolutions that caused an increase in efficiency, productivity and profitability: mechanization of agriculture in 1900-1930; green revolution of the 60s of the XX century; implementation of genetic engineering technologies and the production of genetically modified foods in the 90s of the XX century. In this century, the breakthrough trend in agricultural development is its digital transformation.

Digital agriculture involves the implementation of advanced methods of processing and interpretation of digital data in production and management systems of the agricultural sector of economy [1]. S. Shen, A. Batist, and A. Howard describe the category of "digital agriculture" as the development of "precision farming" term. In their opinion, the digital basis of agriculture includes different types of data in the sphere of production and making optimal decisions what makes it possible to implement more effective management and marketing [2].

Economic and political situation of recent years has once again proved that the agro-industrial complex of Russia is the most important sector of national economy ensuring food and partly economic security of the country. Nevertheless, in the domestic AIC there is a whole range of unsolved problems that hinder its development and the strengthening of national food independence. These problems include the following:

- insufficient development of raw material base (the sphere of raw materials production) as a result of the lack of marketable value of production in several sectors that does not correspond to the focus on accelerated increase in production volumes and limits using of new technologies – especially digitalization technologies in the industry;
- poor level of industry modernization and renewal of fixed production assets; this applies both to the production and to the processing sectors; despite the fact that it is in the processing sector that it is possible and promising to use innovations and to obtain higher production profitability;
- financial instability of AIC enterprises, lack of their own financial resources for accelerated technological development;

- low rates of market infrastructure development what lowers manufacturers' motivation;
- lack of qualified personnel due to the very low attractiveness of working in agriculture sphere;
- low rates of restoration of natural and ecological potential;
- limited information support of agro-industrial complex, etc.

Top target for digitalization of agriculture at the macro level is the integration of objective data flows from agricultural manufacturers with state data into one digital agricultural platform in order to provide global planning in the industry and give accurate recommendations to market participants – including the capabilities of artificial intelligence virtualization and the activation of innovative processes using modern innovation management system [3]. Pilot projects will enable digital transformation of agriculture by means of digital platforms [4].

II. Research Methodology

Research materials included "Strategy for Innovative Development of the Russian Federation", draft concept "Digital Agriculture", "Forecast of the Scientific and Technological Development of the Agro-Industrial Complex of the Russian Federation", data from Russian top technological platforms, scientific publications on the issues of innovative development of agro-industrial complex and economy digitalization. Monographic, comparative and system analysis, as well as logical approach were used for creation of this paper.

Digital transformation of AIC is a part of the national digital economy which in the Strategy of Information Society Development in Russia for the years 2017-2030 is thought of as the activity "where the key factors of production are digital data, and their processing and use in large volumes, including their formation, can significantly increase efficiency, quality and productivity in different types of production compared to traditional economy management during storage, sale, delivery and consumption of goods and services" [5]. However, digital economy should not be thought of as the complex of enterprises created in the digital environment, or as a single industry. Digital economy should form the basis for the development of all systems of economy, should become a practical aspect of information economy and the new economic system of information society.

Among theorists and practitioners of agricultural science, discussions are going about the futures of digitalization. In the course of this study, such expert departments as the Ministry of Industry and Trade and Tsifra Company suggested that in order for the national agriculture to reach the level of digital development comparable to the level of developed countries, a simultaneous realization of several factors is required [6]:

- creation of favorable environment for the development of agro-industrial complex digitalization by the government;
- university training of personnel with professional competencies required for digital environment;
- production of modern production means;
- development of outsourcing or subcontract relations in the RF;
- integration of IT innovations into the digital environment by the corresponding specialists.

In his turn, Igor Bogachyov, CEO of Tsifra Company, believes the main digitalization factor is the availability of equipment with computer numerical control (CNC) for companies. However, much of equipment (86%) of domestic companies is outdated (non-digital), and the level of equipment availability is quite different depending on production type. The best parameters of CNC equipment are observed in mechanical engineering industry (Fig. 1 [7]).

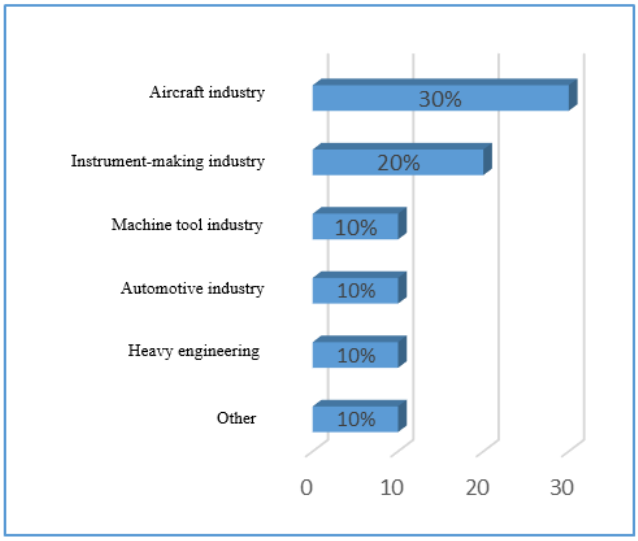

Fig. 1. Share of providing of certain industries with CNC equipment (2018) [7].

Digitalization is of great importance for companies of these industries – they try to simulate as many situations as possible, both at the level of product design and at the level of processes for the production of this product in digital form.

Since 2019, the Digital Agriculture project has been launched in Russia which is supervised by the Ministry of Agriculture. This project is expected to be implemented in 2 stages: the first one in 2019–2021, the second – in 2022–2024. During the first stage (2019–2021), it is planned to implement pilot projects aimed at the promotion of implementation of digital technologies by agricultural manufacturers [8]:

1. "Effective Hectare". This means a single database of lands with the description of their current state and the types of its operation.

2. "Smart Contracts". It is planned to create a network of personal accounts on electronic resources where business entities will be able to draw up applications for state subsidies; the goal of this project is to automate the process of AIC subsidizing.

3. "From the Field to the Port". This program is designed to create effective models for the export of domestic products based on yield forecasts, planned loading of vehicles and transport interchanges.

4. "Agricultural Solutions for Business". This direction is created to enhance the process of implementing innovative developments in AIC.

5. "Land of Knowledge". This project provides the formation of a single base with educational materials and the creation of a training system for highly specialized agricultural specialists in accordance with the current demands of AIC [9].

During this period, the process of determining dynamic seasonal KPI (key performance indicators) for the branches of agricultural sector is formed and provided. Operation takes place using the information system of the Analytical Center of the Ministry of Agriculture of the Russian Federation where the data of several state information-analytical systems are consolidated:

- CIASA (Central Information and Analytical System of Agriculture) where the analytics for the entire industry is represented.
- UFIS AL (Unified Federal Information System of Agricultural Lands) that provides information on agricultural lands.

The second stage of the digital transformation of Russian agriculture will require the active phase of investment in AIC companies. Therefore, the main task of this stage is to attract investments in digital agricultural technologies – primarily from private and institutional investors. So, the processes of implementing the Internet of things, consulting and data processing are possible only with the involvement of private capital. Main investments in the deployment and maintenance of technological equipment for digital agriculture are supposed to be made using business funds.

Based on the state program for the development of agriculture, it is planned to allocate for the implementation stage 4,193.8 billion rubles in total; including 3,417.4 billion rubles from the federal budget what will allow to allocate about 500 billion rubles to the Ministry of Agriculture on AIC development [10]. The draft state program takes into account all types of support for agricultural manufacturers: special tax regimes; priority territories – Arctic, Non-Black Earth Region.

In 2017, according to Rosstat, investments in the digitalization of agriculture were insignificant and amounted to only 0.2% (0.85 billion rubles) of all ICT (information and communication technologies) investments [11]. This is the lowest value by industries what is illustrative of the lack of digitalization of domestic AIC. However, the digital transformation of agriculture increases its popularity among investors. According to Rosstat, investments in Russian agriculture in the first half of 2018 increased by 22.9%. At the same time, state financial support for the industry grew by only 3% this year [12].

Among the main reasons for the growing interest of investors in agriculture, experts note increased demand associated with import substitution, increased profitability, as well as state support for AIC. Investments in large projects in different fields of agriculture are most frequently offered. Proposed investment volume has a range from 50 to 200 million rubles, rarely up to 600 thousand rubles, and a payback period of three to five years [13].

The number of investors differs significantly by industry. The most attractive segment for investors is the production of fruits and vegetables. In this area, 100 projects were started with a total funding of 350 billion rubles. Investors demonstrated significant interest to the processing of agricultural products (26%), animal husbandry (25%), poultry farming (16%), crop production (16%), greenhouse farming (15%) and fish farming (12%). Fodder production and veterinary medicine are unattractive for investors (3%) [13].

The research by INFOLine has shown that in 2018, more than 400 construction and reconstruction projects for AIC facilities were implemented, each of which costs at least 90 million rubles, with the total investment of 1.5 trillion rubles. [14] The Moscow Region takes the first position in the number of projects – 70 billion rubles have been invested in 30 enterprises. Kursk Region is the leader in terms of investments in AIC – the total cost of projects amounts to 179 billion rubles. In the Stavropol Territory where 60 large investment projects in agricultural sphere are functioning, it is planned to bring the volume of investments in AIC to 140 billion rubles by the end of 2024. In the Tver Region, 30 investment projects totaling about 35 billion rubles are planned to start or are already implemented. Grants are allocated in the Kostroma Region for the construction or reconstruction of dairy cattle breeding facilities. In 2015-2018, 12 enterprises received them, and these grants amounted to 65 million rubles. A number of companies have already brought the facilities into commercial operation. In the Republic of Bashkortostan, the list of priority projects includes the creation of modern vegetable and potato storages. In the Kaluga Region, a small project for the cultivation of oyster mushrooms was so successful that it led to the formation of a "mushroom" cluster. The Far East Development Fund (FRDV), as a key investor, invested a huge amount of 5 billion rubles in the construction of the Rusagro livestock complex, and 12 billion rubles in the construction of the first soybean deep processing plant in Russia – in the Amur Region. [12].

III. Results

The problem of the digital development of agriculture in Russia at the present stage is "piecewise" informatization, that is, digital technologies are used not everywhere, but only by separate business entities. This is due to the fact that developers of the software for AIC experience a shortage of funding for their projects, and they do not have complete databases required for the development and operation of specific technologies. Strategy of state policy and private investments in innovative agriculture should be aimed at the development of precision farming, remote sensing, implementation of integration databases and cloud services, and the popularization of mobile solutions and sensors for monitoring and accounting.

In addition to the obvious benefits to agricultural manufacturers, digitalization in AIC will increase the efficiency of the entire value chain of food products. We think that the efficiency of agricultural sector digitalization can be improved by creating an electronic platform for sale of agricultural products where transactions will be concluded not only with intermediate agents, but also with end customers. This will reduce the margin of intermediate agents and will encourage manufacturers to become more actively involved in digitalization process.

Elements of digital economy can be used to monitor lands, crops, optimize settlements between manufacturer and buyer, rationalize the investment and credit system, and social insurance. Digitalization involves the active use of marketing techniques, opposing monopoly, creating the conditions for electronic interaction between all participants [8].

IV. Practical significance

Digital technology platforms are the elements of innovative infrastructure. Their purpose is to provide timely and effective communication, to stimulate direct interaction of farmers with other interested parties (scientific and educational institutions, public structures, authorities) [15]. The following platforms have great potential for increasing production efficiency:

1) Technology of Food and Processing Industry in Agriculture – healthy food products (TFPI AIC).

2) Eurasian Agricultural Technological Platform (EATP).

The idea of creating digital platforms is not new: they appeared in our country as a result of observing many years of foreign experience. Digital platforms abroad function as an institute for the interaction of science, business and state in order to achieve a common goal in any priority sector of economy.

For example, TFPI AIC emphasizes the development of agro-industrial complex and of technologies for the manufacturing of healthy nutrition products. In 2012, this platform was included in the Federal List of Technological Platforms of Russia and is the only agri-food technological platform in the country. According to the monitoring by the Ministry of Economic Development of the Russian Federation, "Technology of Food and Processing Industry in Agriculture – healthy food products" technological platform has been among the five most successful technological platforms of Russia for several years running.

Eurasian Agricultural Technological Platform is created to carry out systematic work on collecting and accumulating advanced achievements of scientific and technical development of world and national importance in the field of agriculture, as well as to attract the scientific potential of member states to jointly solve applied problems in the agriculture of EAEU countries [16].

The effectiveness of digitalization policy is impossible without using space and geographic information products, environmental development technologies, and the development of digital technology platforms. Platforms allow for the virtual analysis and combination of innovative projects, the implementation of the latest developments; such platforms increase the coordination of activities and create conditions for productivity growth [17].

Digital platforms cannot exist outside of virtual space. When it comes to digitalization, it should be noted that the main market for manufacturers is digital one. Digital market is a market where goods are bought and sold using computer networks and specialized software. Working of such platform is provided by a digital platform, that is, a set of software and technical products and a set of rules for the operation of market infrastructure. Well-known examples of existing digital platforms are Uber and Airbnb. For AIC, it is reasonable to create a separate platform for each branch with the implementation of a network of subplatforms. For example, in relation to crop-growing AIC sector, one of sub-platforms can be grain production, and the grain sub-platform can be also divided into several ones – wheat, barley, corn, etc. Participants of the subplatforms are agricultural manufacturers, that is, sellers, and buyers – processors, livestock farms, and animal feed plants [6]. A similar approach can be successfully applied to livestock farming, consulting, education and research, robotics, engineering, trade.

V. Conclusions

Summarizing the above, we can say that digitalization of the Russian AIC is at the initial stage. Digitalization era challenges traditional enterprises to change and adopt innovative technologies to maintain competitiveness and to survive. Approved by law programs for informatization of the industry and of the economy as a whole are currently not well developed and are more aimed at automating already established processes, but do not offer measures for radical economy transformation. Digitalization of agriculture contributes to the significant reduction in production costs and increased financial availability of food, and provides the rational use of natural resources. Creating an optimal digital ecosystem, that is, a market, is impossible without the development of a large-scale network of digital platforms and subplatforms for all branches in agricultural industry.

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