“Big data” and the “Internet of things”, or what accelerates the development of the agro-industrial complex

D Koptilina1*, A Bulgakov2 and A Aleshina2
1 National Research University Higher School of Economics 20 Myasnitskaya str., Moscow 101000 Russia
2 Lomonosov Moscow State University, 1 Leninskie Gory, Moscow 119991 Russia

E-mail: daria.koptilina@gmail.com

Abstract. The development of agriculture plays a significant role in the economy of each country. The entire agro-industrial complex not only shows the standard of living of the population, but it also forms the financial, resource potential of a particular region. Therefore, the study of different ways to improve the efficiency of management is important. The article is devoted to the analysis and understanding of various manifestations of business intelligence in the agricultural sector, which contribute to the development of this industry, making all the processes taking place in it more productive. Particular attention is paid to the development of new technological devices, which clearly demonstrates the importance of using business intelligence to optimize the functioning of all industries of the national economy. It is shown that innovations regarding information processing methods penetrate all levels of the agro-industrial sector, becoming the object of large investments.

1. Introduction
Data are an ever-growing part of our lives. More and more data are produced, and their use, in turn, is increasingly penetrating into all spheres of life. The ability to access, analyze, and manage large amounts of data becomes a prerequisite for the prosperity of leading agribusinesses. This paper reviews the key aspects of relying on ICT technologies in the agricultural sector.

2. Big Data and Emerging Opportunities
In turn, data are related to technology. So, a set of various technological objects, the object of study of which is the technique and methods of interaction with it, the work of people involved in information processing – all this is the concept of Information Technology. By introducing and improving the latest technological base of production processes, the country is achieving a large-scale agricultural development, making production in the industry more productive. That is why, IT technologies are considered to be the fundamental side of bringing agricultural production to a new level.

What is the use of these technologies? They contribute to the repeated increase in profits of enterprises, the level of profitability of production. And on the basis of these financial values, it becomes possible to conduct a qualitative analysis of the return and productivity of the agro-industrial complex. Of course, the possession of large amounts of data and their constant increase is necessary in the management of the modern economy. However, an even more important aspect is the processing of information. After all, all data should be a source of knowledge about current characteristics of the
economy and become a good basis for making forecasts. Therefore, the most important feature of the entire complex of available data is the convenience of their use. Thus, the obtained knowledge has a high level of utility due to the use of IT technologies.

Many agribusinesses are constantly looking for various ways to improve the developed production methods and forecasting, increase yields in order to make the supply chain the most optimal. Therefore, a different perspective on the phenomenon of information is strategically important for maintaining or increasing market the share for specific products or services.

Together with the growing diversity of agribusinesses, the volumes of data that are subject to control and management are growing and diversifying. For example, there are data from social networks and network channels of suppliers, along with data from various agricultural sensors and machines arriving at farmers’ fields, which complement traditional data sources.

“Big data” allows us to improve forecasting and work efficiency, and, consequently, make timely business decisions in a timely manner. Thanks to these technologies, organizations analyze various data sources for their subsequent future interpretation. So, analytics and forecasting opportunities are expanding, and getting the best results is becoming more likely.

Agribusiness needs a large number of indicators. But what is needed now even more than ever is the ability to extract real important information from these growing volumes of data. Big Data can influence agribusiness through the following data or predictions: improved yield forecasts, production, optimized seeds, livestock, as well as a faster delivery of goods to distribution centers, etc.

An information system is necessary for the entire agro-industrial complex. Moreover, the whole process should be divided into several parts. Before starting research and processing, the analysis department should receive information on the main methods used by the organization, its indicators. Further, the information received directly from the agricultural enterprise is checked for compliance with the region and reality in general. And only after this information passes the assessment of professional experts, it would be able to become available to everyone.

There is no doubt that IT systems offering large volumes of information and various recommendations for farming are necessary in order to improve the management of an agricultural enterprise in the agro-industrial complex and other areas. It is also worth noting that modern agribusinesses appear as an intermediary in close relations between suppliers and agriculture. The supplier becomes one of the trusted consultants, as well as a research and development partner. Various sensors are beginning to prevail on modern farms, collecting data from fields and agricultural equipment and provide useful information to farmers and suppliers. Sensors are also becoming common in shipping containers and delivery vehicles in order to optimize the delivery of goods.

Moreover, Big Data can be a fundamental aspect of many new opportunities, including identifying correlations between the state of fields on a farm and weather and raw material data to understand optimal irrigation, fertilization and harvesting, and optimal feeding and livestock delivery. More timely equipment maintenance planning and minimizing energy use can also increase operational efficiency. Predictive analytics can be used to predetermine the demand for seeds, fertilizers and animal feed. This allows agribusiness suppliers to take measures to meet such demand for products. New pricing programs can be created to manage demand in accordance with the existing supply.

Higher profitability and lower costs are crucial for ensuring profitability and improving customer service or any large agribusiness. Big data technologies can improve the analysis of data on profitability, supplier quality, and other critical measures for a thorough analysis of the main reasons for improving quality and reducing overall costs. Data regarding the quantity of raw materials, capacity utilization, and overall equipment efficiency can be combined to further analyze and improve the quality of the entire production.

It is impossible not to draw attention to the so-called ethics of Big Data in agriculture. There is a peculiar asymmetry between farmers and large agribusinesses who have the opportunity to build a new predictive business model for each aspect of agriculture. Farmers are increasingly forced to disclose their personal data about their businesses in exchange for gaining access to the benefits of the technology. However, at the same time, those who transform data into useful information practically
do not disclose any information about internal processes or how and where information will be stored or used.

This indicates a significant change in the independence and autonomy of farmers, as well as the public and private sectors. This asymmetry should be rebalanced using open source data as well as analytical tools that analyze data in the public domain.

Thus, world agriculture is about to enter the so-called era of the “Second Green Revolution”. According to expert estimates, thanks to various technologies based on the “Internet of things”, the yield can dramatically increase to an even greater level than ever even with the emergence of agricultural technology and seed genetics. Thus, according to the forecasts of Goldman Sachs, the digital era in agriculture will lead to a 70% increase in productivity in 30 years.

We are faced with the task of being able to supply 10 billion people with food by 2050, having already reached, at the same time, the ecological borders of our planet. We need innovative solutions that are sustainable and minimize the environmental costs of farming. One of these could be big data analytics. That is why the purpose of this article is to analyze technological innovations in the field of agriculture and their direct contribution to the development of the industry.

Due to the large-scale improvement of technologies, it is now possible to obtain data on various objects, predict the consequences, and draw up an action plan in the agro-industrial sector as well. Moreover, in order for large international agricultural holdings to remain competitive, they not only carry out a huge amount of research and development and attract investment both inside and outside the corporation but also set the main task of implementing data-supported technologies, as they will open the way for their effective optimization of resources, cost reduction, and greater profits.

3. The Internet of Things
The Internet of Things (IoT) allows one to combine data into one set so that it is possible to manage and share it more easily and more efficiently within a single network. Also, with the development of the whole world of technology, software, various platforms, and computers in general are becoming more powerful and more structured. All innovations are used in agriculture to obtain the most efficient automation of production processes. So, it is the Internet of Things that is driving the current technological evolution, combining innovations in the field of technology on remote control, IT applications, using which farmers can improve methods of cultivating and growing agricultural land, including discoveries in machine learning, business intelligence and data science. Thanks to all the above-mentioned modern opportunities, enhanced control over the state of farms and the collection, storage, and processing of large amounts of data is carried out.

All this leads to the fact that IoT projects are becoming more and more necessary, as they help not only to increase profits and business competitiveness but also to increase the level of productivity. The consulting company in the field of information technology, Gartner, predicts profits from the use of the IoT in agriculture by 2020 at $ 76 billion, which corresponds to 4% of the total effect. And crop production can increase by as much as 70% in 2050, which is equivalent to $ 800 billion worth of products, according to Goldman Sachs. This is likely to come true due to the introduction of precision farming, i.e. more accurate processing and care of fields.

The equipment that collects data for later use in order to increase profitability and efficiency in the field of agriculture, is now attributed to the investment sector “AgroTech.” So why does advanced agriculture deserve investment? First, agriculture accounts for 10% of the world’s GDP. At the same time, this area receives much less investment than others. Moreover, investments in AgroTech occupy only no more than 0.5% of the entire industry. And also, a very small amount of venture capital investments can be a source of a major breakthrough in the field of agriculture. The successful development of innovation and its application have all the possibilities to dramatically increase production efficiency and the volume of the crop itself, which was not achieved even with the introduction of the first technological means. Most of all, it is estimated that there is investment in farming e-commerce and biotechnology. And various applications for farmers and the IoT system
receive the least investment. It is necessary to take into account that startups in the field of agricultural enterprises that use new high-speed technologies offer such services and products that boldly take root in the global market, competing with others due to more attractive quality and price.

I would like to mention a few large corporations in this area and their transactions involving large investments. With the development of the Internet of things in the field of agriculture, agribusiness companies can acquire enterprises that specialize mainly in working with data. A prime example here is the purchase of the Big Data company, Climate Corporation, by the Monsanto biotechnology leader. After this transaction, which took place in 2013, one of the largest transactions of 2016 took place in the form of the acquisition of the Bayer’s pharmaceutical concern by the Monsanto company itself.

Another argument in favor of the development and implementation of agrotechnologies is the maintenance of leadership positions by large corporations. After all, there is a possibility of reducing their profits due to the emergence of many startups with innovative solutions in the field of agriculture. This is precisely the reason why large companies are striving to track all the latest technologies through not only attracting investments and conducting various research projects but also acquiring these startups.

Obviously, agricultural production is directly related to the further distribution of products, that is, with logistics. One of the latest innovations of the National Technology Initiative in 2017 was the FoodNet roadmap, which was designated as the intellectual market for the production and distribution of food and products with individual logistics. With respect to the “big data”, it is planned to create a special control system and a network of large wholesale and retail food centers, i.e. the FoodNet focuses on the infrastructure of this area. Implementing all the projects planned will allow the Russian agro-industrial complex to reach a new level, becoming more technological and less dependent on imports. Not least, it will also help promote Russian companies and expand a number of prospects for their development and occupy more than 5% of the global market.

According to the estimates of the working group of this project, the market volumes of all segments will grow at a high rate every year. On average, each one will demonstrate a 10% increase. Thus, the most accelerated development is considered to be “smart agriculture”, whose market may grow by $434 billion by 2035. At the same time, it is noted that the development will be carried out mainly due to private investment, despite various state forms of financing.

4. IoTAg: The Internet of Things in Agriculture

As already mentioned, the Internet of Things or IoT gradually fills all walks of life. The field of agriculture was not spared; therefore, the result of the vertical development was the Internet of Things in agriculture - IoTAg. This segment is just beginning to develop, but thanks to its fast pace, it is becoming one of the most attractive businesses for investment.

Different agencies analyze the IoT market, including in the field of agriculture, but since there is no exact unified methodology for assessing the structure of the market and the market itself, the estimates can vary greatly. Moreover, different agencies may affect and take into account different stages of the agricultural production process, companies of different specializations, etc. So, some companies focus only on the internal production process, others analyze the scope of precision farming and enterprises specializing in agricultural technology. Some agencies deal only with the financial side of the business, analyzing the ratio of expenses and revenues from the use of various technologies in the agro-industrial complex.

Thus, agriculture is becoming more and more integrated due to the expansion of the range of self-managed machinery for agriculture with built-in special sensors. The faster new IoTAg technologies are introduced into production, the faster the cost of machinery and equipment decreases. And this, in turn, allows even small farms to have access to the latest technologies for the agro-industrial complex.

Unfortunately, agriculture in Russia is not as efficient as in other large economies. Indicators of exports and domestic production are high, but because of the technological lag in the field of
agriculture, the gross value of agricultural products in Russia is about 24 times less than in the United States. So why does Russia have such a low level of digitization of production in agriculture?

First, about 30% of the production volume in Russia falls on personal subsidiary farms. Moreover, agricultural enterprises often do not have the funds to invest in technologies. This is due to the large accumulated debt of loan companies. According to the data, more than 1.5 trillion rubles in 2016 were issued manufacturing companies in agriculture. Also, not all enterprises of the agro-industrial complex can afford to buy modern equipment. Therefore, technical support for farms in Russia is at an extremely low level. There is no widespread use of technologies that help farmers in maintaining their fields at a qualitative level [15].

More than that, only large manufacturers in Russia can easily deliver their products to store shelves if they are interconnected with retail chains. Therefore, smaller enterprises are going to reduce the cost of their products in order to sell it to intermediaries in the form of wholesale organizations. The latter will only ensure the delivery of products to stores. All this testifies to an excessively long logistics chain. The result is that the quality of products is significantly inferior to its price, as banks and wholesale and retail trade enterprises receive an almost 100% margin from sales.

However, since the chain of intermediaries is long, a large number of costs arise, which significantly reduces the margin of an individual participant in the resale of products. This can be fixed by digitalization. Logistics will be easier, the margin will decrease, retail prices will fall, and consumption will increase. This means that the margin can be approximately doubled. Therefore, the recommendation of the consulting firm “J’son & Partners Consulting” was the use of the direct sales model based on the Internet of Things. This model is based on the fact that the manufacturer produces exactly as much as the consumer needs, based on analytics. And also, there is a continuous exchange of information between retail chains, wholesale companies in order to minimize the use of warehouses and other intermediaries.

This will help reduce product prices and improve its quality, increase consumption and, consequently, food markets. From this it is possible to identify one of the main goals of Russia, which is to increase both the volume of production and the volume of consumption of agricultural products. At the same time, they should remain of high quality and affordable for the consumers at the current level of income.

So, if we ensure the integration of suppliers, companies, sales, logistics, and transport along with an increase in the coherence of all stages of the agricultural food production process, then with the help of digitalization, food prices can be reduced. Moreover, it is possible to significantly improve the entire logistics system by reducing the number of intermediaries and ensuring consumer access to products faster and easier. In other words, companies can significantly improve the competitiveness of their products, increase their profits. But we must not forget that such digitalization requires business reorganization.

Thus, the penetration of IoT into all areas of agriculture will allow:

- Reduce the cost of food by 2-3 times, without affecting quality characteristics;
- Further increase the level of food consumption;
- Increase the level of margins in the business of agricultural enterprises.

This, in turn, can be achieved only if the level of productivity in agriculture increases by performing the following points:

- Using the cloud model of information technology consumption instead of spending on the purchase of traditional equipment, increasing the automation of agricultural production;
- Moving to the rental model of equipment, its sharing with other companies and its payment according to the volume of consumption (Uber), which makes new technological equipment more accessible to farms of different levels of development
- Accelerating the logistics system in order to avoid high costs of maintaining the quality and condition of products during transportation.
5. Conclusion
Thus, it can be concluded that the areas of business intelligence, namely big data and the Internet of Things are the basis for the latest innovations that are gradually penetrating the field of agriculture, helping to improve the production of agricultural products, simplify the process of their cultivation and care and reduce the costs and expenses of companies.

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