Features of the Development of Industry 4.0 in the Agro-industrial Complex

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Abstract: This article is devoted to the peculiarities of the development of industry 4.0 in the agro-industrial complex, analyzes current trends and prospects for the development of the application of industry 4.0 in the agro-industrial complex. Currently, environmental conditions are changing at a high speed and, as a result, an important factor in increasing competitiveness is the optimization of business processes. This issue can be solved with the help of digitalization of agricultural production.

1 INTRODUCTION

Few companies in this industry are willing to invest in the digitalization of agriculture. There are a number of reasons for this fact: enterprises are not ready to take risks by introducing innovative products in production, fearing that the installed product, equipment, software will not pay off. A large number of solutions cost a fortune, and in addition to purchase, installation, there can be expensive maintenance.

A significant factor that hinders the development of digitalization in the agro-industrial complex is that the product developed by the company is not finalized on the spot individually for the enterprise. Each manufacturing enterprise has its own differences, the same product will not be a "panacea" for all companies, it needs to be improved.

The five main issues that will affect global agriculture and the food chain in the future will be: demographics, limited resources, climate change, food waste, government policies (Bondar, 2018).

With population growth, fertile farmland is expected to decline.

According to the FAO (Food and Agriculture Organization), soil quality is deteriorating everywhere due to excessive use of fertilizers, deforestation and climate change due to global warming (Tuskov, 2018). By 2050, the amount of arable land per person is projected to be a quarter of the total available in 1960.

By 2050, 2.4 billion people will be added to urban areas, and this will help develop city farming, the refrigeration market and cold store chains, as well as lead to an increase in demand for processed food and protein products.

Already today, farmers face the problem of urbanization. And that raises an important question: who is going to farm in the future, when climate change may make it even more difficult to grow rich crops on depleted soils?

In addition to urbanization, another major challenge facing society is an unbalanced food value chain. Food waste is what leads to imbalances in the food value chain in agribusiness that is virtually non-existent in other industries. Over 30% of food is wasted every year, and 800 million people go to bed hungry every night.

Therefore, the main goals of agriculture 4.0 include balancing between food production and consumption. Agriculture 4.0 will need to take into account both the demand side and the supply side of the value chain in the food scarcity equation.

In general, agriculture 4.0, the coming agricultural revolution, must be sustainable, based on the achievements of science and technology, use sophisticated technologies such as robots, temperature and humidity sensors, aerial

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photographs, GPS technology, and so on (Shestakova, 2019).

2 MATERIALS AND METHODS

Business owners largely refuse to introduce innovative solutions for agro-industrial production because when installing new digital equipment, it may be necessary to train employees to work on a particular equipment or program; hiring additional employees. New hardware or software may not "match" existing hardware.

However, in Russia there are solutions for digitalization in the field of agro-industrial complex, which help to increase production efficiency and guarantee payback (Shestakova, 2019).

The Russian company Matler has developed an innovative solution based on computer vision and neural networks, which makes it possible to increase the efficiency of manual labor in conveyor production. Morigan.Lean - allows you to keep an online record of the actual output of an employee to motivate employees for results.

The system provides online control of intermediate and final results of order fulfillment: if an employee of the conveyor fails to comply with production standards, the production director receives information about deviations (sms, email). The system allows you to increase labor motivation, since payroll depends on actual output. The development allows you to increase the efficiency of the agro-industrial complex with existing resources.

The software has an intuitive interface that allows you to quickly learn how to use the system. The system allows the shift foreman to automatically generate a report for each employee.

The system has already been implemented at several poultry farms. During the use of the solution, the productivity of employees increased by 50% in conveyor production; the speed of the conveyor has been increased to the maximum with a simultaneous reduction in the number of employees involved. The released people were moved to other areas.

Today, the optimization of business processes with the help of digital technologies is the basis of a competitive advantage for agro-industrial enterprises.

The development of agriculture will largely depend on the development of geographic information systems (GIS), remote sensing (RS) and global positioning systems (GPS).

Combined with indicators such as yield, quality and disease prevalence, they can indicate the most appropriate intervention in a given area. In addition to assisting in farm management, they can be used by consumers to determine the origin of products (Minchichova, 2020).

This is the real starting point for agriculture 4.0. Modern agriculture works by using data from various sensor technologies to improve the accuracy and efficiency of farming.

Depending on the nature of the task, human intervention may no longer be required. Sensors can range from imaging technologies to GIS and equipment sensors. Others, such as smart crop sensors, can analyze variables such as water, soil electrical conductivity, altitude, organic matter content, soil nitrogen, and pH.

Potential applications are numerous, such as warning producers of unexpected frosts. Asparagus farmers in California are using smart sensors to double their yields while reducing water use by 6%. On-farm data can be used to plan the movement of agricultural goods to reduce soil compaction.

Harvesting can be improved by synchronizing the movement of vehicles. At the field level, environmental data can be used to ensure proper fertilizer levels, cost savings and pollution reduction. Combined with developments in automation, this information revolution could very well lead to minimal human intervention. Implementation of precision farming requires new hardware and software, including robots.

They range from systems with limited mobility such as robotic parlors to AgBots that perform field tasks such as seeding, weeding or spraying. Some, of course, are already on the market. Smartphone controlled manure robots have been used for several years at Coleg Llysfasi, Ruthin. There are also automated pasture grazing systems.

They use solar-powered bot pairs to move lines of electrical fence equipment, communicating with each other via Bluetooth to maximize pasture use. Feeders can be programmed to deliver different feed mixes to livestock at a given time, and AgBots weeders can automate tedious tasks like harrowing. This type of artificial intelligence (AI) will lead to even greater efficiency and could lead to new farming practices based solely on data.

The ability of devices to work in automatic mode will be determined by their ability to interact both with each other and with data centers. As controllers of these devices, future farmers will need systems that allow them to collect and analyze data and initiate tasks. Such IoT-enabled control systems are already under development, such as Agrivi or BovControl.

They also exist for collaborative supply chains such as Farmers Web. These systems interact with

cloud data stores to archive, retrieve and compare data. In the future, this data will be integrated with inventory, financial and business planning data to give farmers an overall view of their business.

3 RESULTS AND DISCUSSION

Regardless of the presence of robots and artificial intelligence, agricultural machinery will continue to improve. Modern tractors are already equipped with modern on-board computers for processing GPS, GIS and remote sensing data. The next step is fully autonomous or controlled driverless tractors equipped with sensors and cameras to monitor the condition and health of plants. As agricultural equipment is likely to be equipped with a wider range of accessories in the future, making it larger and heavier, new components are being developed, such as highly flexible tires and more efficient engines.

These advances will enable businesses to improve profitability without compromising the environment.

Agriculture 4.0 must strive to become independent of vast amounts of fresh water, synthetic fertilizers and pesticides. Thanks to science, farmers will be able to grow crops in drylands and tap into a range of undervalued resources, such as seawater for crops[3,4].

Finally, city farming will increase its presence in the agro-industrial complex with new farming methods (vertical farming, hydroponics, aquaponics, insect farming, algae farming, cultivated meat, etc.).

The good news is that digital and technological advances are making urban farming more affordable.

Every year, new agricultural technology startups enter the market. Business leaders Bill Gates, Richard Branson, Jack and Susie Welch, along with venture capital firm DFJ (known for its investments in Tesla and Twitter) and food conglomerate Cargill, have invested in Memphis Meats, a pioneering lab-grown cultured meat company. And the SoftBank Vision Fund, led by Japanese billionaire Masayoshi Son, has invested millions of dollars in vertical farming startups.

Technology giants such as CNH, John Deer, AGCO, Mahindra, Bosch, Mahindra, Kubota, Trimble, Topcon, etc. have invested millions of dollars in precision farming technology, automation and data analytics.

Agricultural machinery manufacturer CNH recently added precision technology to its portfolio in response to growing demand for precision farming. The technology enables real-time soil monitoring, weather monitoring, data collection for sustainable weed control solutions, and helps the farmer make important decisions (Ivonin, V. M., 2009).

Artificial intelligence has various applications in agriculture, ranging from computerized water systems and driverless (autonomous) tractors / combines to a farm planner: fertilizer and plant protection stock management, agronomic research, equipment optimization, financial accounting - all in one place!

If we go back and look at the history of the development of agriculture, we will see that the main driving factor in agribusiness, as elsewhere, is profitability. Digitalization and robotization meet this requirement.

Using a simple tablet, you can manage the entire farm: control the operation of tractors, inspect cows in a remote pasture by sending an agricultural drone there, program irrigation, and perform field mapping for optimized localized fertilization (Polyakova, 2011).

Smart farming is a way to increase productivity and protect the environment, which is so often said.

Here is a recent example. In 2019, New Holland (part of CNH) introduced the world's first mass-produced T6 methane tractor at AGRITECHNICA 2019 and won the 2020 Green Tractor of the Year award.

4 CONCLUSIONS

It is worth noting that national governments must understand the importance of the new agricultural revolution and structure state support measures in such a way as to benefit every level of farmers.

It doesn't matter the type of farm, whether it's row crop farmers in the US or Brazil, mid-sized European grain farmers, or small farmers in developing countries like India or Mexico.

For example, agriculture 4.0 in Asia or Africa will not soon become a reality without a special plan and government support, since most peasant farms are far from even 100% mechanization and are now at the level of agriculture 0.

Governments, and especially those in developing countries, could revitalize the agricultural industry by helping farmers innovate and achieve self-sustaining production. In the modern world, it is not the import of food products that is appropriate, but the import of innovations and technologies.

“Digitalization can increase yields by 10-30%, reduce costs by 5-15%, and these are quite conservative estimates. Without taking into account the depreciation of the purchased equipment,

profitability can be increased by two or three times," Maxim Nikitochkin calculates. Despite the inevitable increase in manufacturers' expenses for technical re-equipment, the costs will be recouped in a short time.

"In developed countries, the use of such technologies makes it possible to save 5–10% on costs and increase yields by more than 10%," Anton Vinogradov gives a close assessment. "Given the current stage of technological development of domestic crop production, the expected effect from the introduction of such solutions in Russia is significantly higher," the expert believes.

Already at the initial stage, many enterprises can save 25% due to relatively simple techniques that are not even directly related to business digitalization. These are the optimization and standardization of business processes, training and development of personnel, the introduction of a lean manufacturing system, effective models for managing purchases and stocks, and optimizing logistics routes (Porfiriev, B., 2010).

This also includes measures to monitor equipment, reduce its downtime and fuel costs.

The transformation of the industry will take time: small enterprises operating in the old fashioned way are still relatively competitive, including due to cheap labor. In addition, it is necessary to ensure an acceptable level of Internet penetration in Russian villages, as required by the integration of the agro-industrial complex into Industry 4.0.

The degree of development of industrialization and the widespread introduction of new technologies unquestioningly lead to the transition of the world into a new digital era. This period is characterized by the rapid development of high technologies, penetrating into all spheres of our lives. The widespread use of cloud technologies, the Internet of Things (IoT), virtual and augmented reality, 3D printing, the development of quantum technologies, robotics and other technologies as a result has become the driving force behind the Fourth Industrial Revolution, also known as Industry 4.0.

The conducted study allows us to conclude that the digitalization of the agro-industrial complex will entail the release of better products. In addition, "Industry 4.0" will lead to the creation of more flexible systems, the participants of which will exchange information via the Internet, which in turn will significantly increase labor efficiency and reduce costs in production processes.

Digitalization is an absolutely logical process that takes place in all areas of the economy: in marketing, retail, and service (Nikoláeva, L. B., 2018). Modern information systems and neural networks will be able to analyze more factors and significantly increase the efficiency of any business process. Of course, this also applies to agriculture.

Any agricultural producer in a competitive market faces two main tasks: to minimize the cost of production and increase the net income received, while maintaining product quality at a consistently high level. To solve them, at all stages the production process must be fully manageable and transparent. For example, you need to clearly, step by step track the value chain for each unit of production. To do this, a single information space is being created at an agricultural enterprise, where high-tech equipment, analytical and management IT systems exchange data non-stop.

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