Digital Mainstream in the Promotion of Food Industry Products

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Abstract. Digitalization of the food industry involves the use of modern digital information technologies at all stages of agro-industrial production, i.e. digital transformation of the industry, as well as other high technologies formed at the intersection of electronics and robotics. Information technologies, digital technologies, science-intensive technologies are currently closely intertwined, and their implementation in the industry depends not only on the degree of computerization, but also on the level of use of systems, devices and mechanisms that allow for the possibility of autonomous use (without human intervention). The article outlines well-known advanced innovative technologies, including "smart", "precision" farming, artificial intelligence, nanotechnology, biotechnology, off-ground growing of plants (hydroponics) and vertical farming, satellite navigation systems for combines and other equipment, autonomous robots, unmanned aerial vehicles, "Internet of Things", blockchain technologies. The characteristics of existing digital technologies are given and the options for using artificial intelligence in the food industry are described. In addition to artificial intelligence, complex agricultural technologies are: "smart" agriculture, "smart farming", "precision farming", etc.

1. Introduction
The growth of the population of the Earth dictates the need to increase the volume of food production. With the volume of production areas unchanged, one should look for new innovative methods of production that make it possible to reduce the cost to the maximum and increase the volume of production. The government's course towards informatization of all spheres of public life through the introduction of digital tools and mechanisms is aimed at launching the hidden potentials and reserves of existing traditional methods and solutions to problems. The use of digital technologies allows you to build the entire reproduction cycle in a new way, exclude irrational decisions, and more accurately simulate the tactics and strategy of the development of events.

2. Formatting the title, authors and affiliations
The research methodology includes a combination of general scientific methods and techniques: a combination of qualitative and quantitative approaches, comparative and systemic analysis. Of
considerable interest, from the point of view of the problem under study, are the works of A.I. Altukhov, M.N. Dudin, A.N. Anishchenko [1], Afanasyeva Yu. I., Shurpo A. N. [3], Dudina M.N. [7], etc. During the study, the works of foreign scientists were studied: Akatkin YM, Karpov OE, Konyavskiy VA, Yasinovskaya ED [18], Desmarchelier B., Regis PJ, Salike N. [19], Laosutsan P., Shivakoti GP, Soni P. [20] and others; materials from Internet sources [10; 15; 16, etc.]. Purpose of the article: scientific and practical substantiation of the need for the introduction of digital technologies in the food industry. The novelty of the research lies in the fact that the article is an independent scientific study of the digital mainstream in the promotion of the food industry.

3. Discussion and results

The information and digital revolution is affecting all sectors, and the food industry is no exception. Digitalization has affected only individual enterprises of the largest and most advanced agro-industrial holdings of the Russian Federation, mainly in the form of electronic feeding systems for animals on farms and poultry farms, in some cases in the form of geolocation systems and elements of "smart" farming. In the West, such systems and many other intelligent solutions have long been used within the framework of the farming system 4.0 (Agriculture 4.0), and promising solutions are already being implemented that define the foundations of Agriculture 5.0, where artificial intelligence and robotics almost completely replace manual manual labor [2]. Implementation of almost all known advanced innovative technologies, including "smart", "precision" farming, artificial intelligence, nanotechnology, biotechnology, off-ground growing of plants (hydroponics) and vertical farming, satellite navigation systems for combines and other equipment, autonomous robots, unmanned aerial vehicles, "Internet of Things", blockchain technology is impossible without the use of modern digital information technologies, as well as other high technologies, including electrical engineering, electronics and robotics (Table 1).

There is a problem among food manufacturers related to the characteristics of food processing plants. The challenge is that raw materials are often heterogeneous. Each unit of potatoes, carrots, tomatoes, apples, etc. differ from each other in size, shape and weight. Millions of units of specific vegetables with different characteristics pass through the sorting. Modern grading systems use video recording, near infrared spectroscopy, X-rays and lasers to measure and quickly analyze all the necessary characteristics of the vegetable as it moves along the conveyor. Whereas the old automatic sorters were just focused on good / bad quality sorting. Machine learning creates the ability to sort products for optimal use [7].

Companies are starting to use sensor systems to improve the cleaning of food processing equipment. The technology, in theory, could save hundreds of millions of dollars in the industry. Artificial intelligence can reduce the time it takes to clean equipment, which significantly saves money on water, energy and equipment downtime.

The modern method uses ultrasonic sensing and optical fluorescence imaging technologies to transfer information to an artificial intelligence program to control the amount of food and accumulations of microorganisms in the equipment. Artificial intelligence automatically optimizes the process to keep the cleaning system running for as long as it really takes.

Also, artificial intelligence can now help food companies create new products. For example, in numerous restaurants and other locations, Coca-Cola has installed self-service soft drink vending machines that let you customize your drinks. Customers can use these self-service machines to theoretically create hundreds of different drinks by adding different flavors to their base drinks. These thousands of vending machines, each serving hundreds of different drinks a day, have created a wealth of data about consumer preferences.

Artificial intelligence technologies are key in developing new digital solutions. In addition to artificial intelligence, complex agricultural technologies are: "smart" agriculture, "smart farming", "precision farming", which combine the use of several innovative solutions or products at the same time [9].
Table 1. Existing digital technologies in the food industry.

| Digital technologies, solutions, products | Scope (area) of application                                                                 | Implementation (penetration) level                                      | Life cycle characteristic |
|------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------|
| SMS notification                         | Warning about impending adverse natural events: frost, drought, extreme heat, heavy rain, hail, etc. | All digital mobile networks of GSM standard                            | Obsolete technology      |
| Unmanned vehicles, remotely controlled (human) | Unmanned drones for creating electronic maps of fields, monitoring crops and gardens, ongoing work, protecting territories, etc. | Widespread in the world, limited use in the Russian Federation           | Modern technology        |
| Internet of Things (IoT)                 | Data collection and control over all facilities and network solutions, platforms and applications | Limited distribution in the world; absence or experimental use in the Russian Federation | Modern technology        |
| Blockchain                               | Distributed registers for tracking seed material, raw materials and finished products, bidding, quality control at all stages of the technological cycle | Widespread in the world, limited use in the Russian Federation           | Modern technology        |
| RFID solutions (marking and chipping)    | Plant marking, Livestock counting by chipping, tracking its movement through pastures, vaccination, selection work, identification of sick animals, etc. | It is becoming a mandatory daily routine in the world. In the Russian Federation, the use of microchips is recommended for breeding breeding animals | Mature technology        |
| Artificial intelligence                 | Increasing the efficiency of breeding processes by taking into account genetic and phenotypic parameters, increasing yields due to the built-in autonomous system of crop care, reducing the cost of maintenance and repairs due to predicting equipment breakdowns | Limited or experimental worldwide distribution; absence or experimental use in the Russian Federation | Advanced technology. At various stages of readiness and implementation |

It is obvious that understanding production processes is one of the most important conditions for achieving effective performance and ensuring sustainable development. Obtaining information about the progress of the production process at its different stages, about the condition of the equipment - all this is the most important condition for making an effective management decision, which makes it possible to reduce the likelihood of certain risky situations, to identify bottlenecks, and also to reveal hidden reserves. In this regard, the use of various sensors is becoming widespread in the food industry.

Prospects for the development of this area are associated with the widespread use of Big Data technologies. Integration of various digital assets of an enterprise allows organizing smart production
with a wide range of software interaction of various types of equipment. In the long term, the integration of information systems will allow "to form a single automated platform that traces the entire value chain in the production of food products, not only within the enterprise, but starting from the field (farm)." Collecting and analyzing data at points of sale of food products will allow you to choose effective suppliers of raw materials, predict yields, and hence the expected production volumes of various types of products. Such a partnership will be especially important for increasing the stability of interaction between business entities, since it allows taking into account the possibilities of the regional environment, contributing to the implementation of additional organizational advantages precisely because of the proximity of the location as a dominant factor [14].

One of the promising and promising technologies is SD-printing, which opens up unique opportunities for the development of the food industry. The main direction of using this technology is associated with the ability to "print" food with specified parameters [17].

Automation in the food industry today has gone far beyond the already familiar conveyor belts and labeling machines. Modern devices make it possible not only to pack food (a function that previously could only be performed by humans), but also to sort and select products in accordance with established quality criteria. Robot manipulators can intelligently coordinate the processes of moving products, providing them with individual packaging. This applies to all types of food, from chunks of frozen fish to individual cookies. The uniqueness of robotic manipulators lies in the exceptional speed and flexibility of the operations performed and the minimization of errors, which, according to experts, amount to one in a million.

4. Conclusions
The coronavirus pandemic hit most countries in early 2020, at a time when the food system is long overdue to overhaul its course to improve nutritional and environmental outcomes and accelerate poverty reduction. With the acceleration of digitalization, quarantine restrictions can unexpectedly become a kind of tailwind and initiate favorable changes. It's time to whistle up to ensure that there is an environment conducive to finding digital solutions that can move us closer to achieving our Sustainable Development Goals by fostering deconcentration, decentralizing product traceability and disseminating open data. If this can be achieved, we can harness the creative energy, innovation and daily needs of the 7.7 billion farmers, entrepreneurs and consumers that make up the global food system to change course towards a more sustainable future.

Digital technologies used in the Russian food industry are rare and are at the experimental stage of implementation. There are very few Russian developments in the field of artificial intelligence in the food industry. International experience shows that in the foreseeable future, the combination of already developed technologies (unmanned vehicles, the Internet of Things, chip, blockchain) with the capabilities of artificial intelligence and robotics will allow the concept of the so-called. "Smart" agriculture, which involves the integrated use of all innovative solutions that maximize the automation of agricultural production and increase its efficiency.

The digitalization of the food industry will give an impetus for the innovative development of the industry, bring significant economic benefits and help to achieve the final result in the form of strengthening food security. In the context of global digitalization, the tasks of ensuring food security in Russia in the foreseeable future are assigned mainly to artificial intelligence technologies.

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