Automation of the Agricultural Sector of the Republic of Uzbekistan

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Abstract. In the agricultural sector of the Republic of Uzbekistan, a tendency to automate production and business processes can be seen. Agriculture automation helps to significantly reduce the amount of manual labour, while increasing work efficiency. It is possible to single out the following practical advantages of introducing automation in the agricultural sector: it becomes possible to manage production, technological and business operations in an optimized and effortless manner; the competitiveness of the goods is growing through improving the quality and reducing the cost; the productivity of agricultural enterprises increases; cost minimization leads to a drop in the cost price of manufacture of products, and a manufacturing organization can offer the products at a price, which is affordable for the buyer and at the same time profitable for the manufacturing organization. The use of modern technologies for the 'intellectualization' of agriculture makes it possible to preserve and restore the beneficial properties of groundwater and soil; to provide environmentally safe and effective pest control; to remotely monitor compliance with the certification requirements of organic agriculture. It is necessary to automate not only production, but also business processes in the agricultural sector. The main goal is to increase the productivity of enterprises, minimize the number of errors associated with the 'human factor,' and reduce the amount of 'manual labour'. The article substantiates a systematic approach to the formation of the information space of an agricultural enterprise, taking into account the needs of all participants in process management, the choice of a software and hardware platform and methods for automating the software development process.

1 Introduction

The integration of Uzbekistan into the world's agricultural production and ensuring its food security require the sustainable development of the agricultural sector of the country, its high adaptability to changing conditions, and susceptibility to innovation. The development of agriculture should follow the path of ensuring high efficiency and profitability of production. Under these conditions, the strategic goals of improving the country's agro-

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industrial complex are to continue modernization and transit to an innovative development model.

At the present time, the interest of economic entities in information systems is constantly growing, which is facilitated by a number of reasons and circumstances. Firstly, qualitative transformations in the information processing industry contribute to the widest dissemination of information technologies in all fields of human activity, which determines the need for qualitative transformations in management; secondly, the political and economic transformations carried out in our country in recent years are pushing leaders of various ranks to look for ways to increase the efficiency of their economic structures in the market economy conditions. The use of scientifically based methods for the development, implementation and operation of an automated information support complex for the management of any economic entity makes this goal achievable. Moreover, the competent implementation of such methods can quickly increase management efficiency, reduce non-production costs, and also bring economic activity planning to a completely new qualitative level.

The use of flexible automation means allows solving the issues of predicting situations in the market; conducting the modeling of real economic relations and operational economic analysis; justifying the adoption of managerial decisions in conditions of various kinds of uncertainty. The use of automated information systems is also of great relevance for solving the problems of management of agricultural production.

An analysis of the existing technologies of automated systems and the results of their implementation in the management of agricultural enterprises showed that with all the variety of methods and all the breadth of the range of tasks to be solved, the state of knowledge of the problem of automation of agricultural management at this stage seems to be extremely unsatisfactory. Existing projects and developments, as a rule, are hopelessly outdated, having become outmoded and obsolete. The principles for the formation of such systems were developed in the late 1960s. The vast majority of automated control systems used hardly take into account the specifics of agricultural production, are unreliable and very difficult to maintain, and require significant operating costs. In the current conditions of the economic crisis, such solutions are ineffective.

Information technologies in the agro-industrial complex are of current importance, which implies their active implementation. These trends are embodied in specific solutions. The development of agricultural enterprises and associations, agricultural service formations is ensured through the use of office equipment and means of communications, by virtue of the informatization of labour tools, creation of automated work places and information systems for industry and functional specialists (farmer, accountant, economist, agronomist, livestock specialist, mechanic, specialist in land management, etc.), the information basis of which is agro-technological planning, a cost-price analysis, a financial and management accounting system with the organization of information transfer between workplaces.

Information technologies and automated control systems in the agricultural sector should primarily be aimed at solving the following tasks:

- In the field of planning – accelerating the transition to more advanced methods of planning production, purchasing products and logistical support for farms based on progressive norms that meet the requirements of a proportional and balanced development of agro-industrial production; optimization of the structures of economic sectors, crop areas, composition of fixed assets, distribution of capital investments; creation of methods for automated development of norms and standards.
- In crop production – the rational use of land reserves, crop forecasting, the qualitative improvement of breeding and variety testing, the development and implementation of intensive technologies for the production of various crops.

The process of introducing information technologies is carried out in stages. Thus, the first stage provides for the creation of automated workplaces (AWP) for specialists of all profiles. The second stage provides for uniting the workplaces of managers into local computer networks. The third stage combines local networks of a departmental or regional body with local information networks of enterprises and organizations that belong to this sector or located in this region, using Internet and Intranet technologies.

An analysis of foreign literature has shown that there are numerous examples of automation in the agricultural sector [1-8]. The proposed paper deals with the automation of the agricultural sector of the Republic of Uzbekistan.

2 Materials and methods

Research methods: analytical reviews, comparative analysis, experimental testing, mathematical modeling of processes.

The level of implementation of research results:

- On the subject of the study, the accumulated experience and publications in the field of information management in the agricultural sector management system both in the Republic of Uzbekistan and in foreign countries were studied and analyzed.
- An information and communication environment was formed for the agricultural sector of the Republic of Uzbekistan. In cooperation with the Council of Farmers, Dekhkan Farms and Landowners, Farmers and the Population, an electronic database on the management and maintenance of farms was created.

The scope of scientific research: agricultural sector.

3 Results

The dynamic development of an agricultural enterprise and the economy as a whole requires creating an information infrastructure both at a separate enterprise and in the state as a whole. Information systems play a special role in increasing the level of automation and informatization of production and management processes in the agricultural sector. They are widely used during rational decision-making in management, engineering, economic, statistical, mathematical calculations, planning and control of economic activities, the formation of data banks in the field of breeding, modern means of chemicalization, plant protection and ensuring the appropriate technical condition of complex machines and equipment, use of secondary raw materials. Information systems make it possible to minimize costs and increase the promptness of managing enterprises in the agricultural sector as a whole.

The modernization of the agricultural sector is based on the transition to 'smart' agriculture, which means agriculture based on integrated automation and robotization of production, the use of automated decision-making systems [9], state-of-the-art technologies for modeling and designing ecosystems [10]. At that, a particular attention is paid to the modeling of various subsystems in the automation of the agricultural sector. These problems are well studied in various branches of science and technology: in modeling in geomechanics [11-13], in solving problems of pattern recognition [14-18] and classification [19, 20], medicine [21], in tracking objects based on a Kalman filter [22], modeling of personal identification processes [23], creating a model of an access control system [24], creating models to improve image contrast [25], when modeling predictive indicators [26] and in sports research [27], as well as in hydromechanics [29, 29]. In our case, for modeling and automatic control of the agricultural sector, the PHP programming language and the MySQL database, as well as various methods of data mining [30, 31], were used. Here,

special attention is paid to the storage of information, as well as information security measures.

The intellectualization of the agricultural sector allows, on the one hand, reducing the amount of excessive use of external resources (agrochemicals, inorganic fertilizers, fuel, etc.), and, on the other hand, maximizing the use of local production factors (organic fertilizer, biofuels, renewable energy sources, etc.). The use of modern technologies for the 'intellectualization' of agriculture makes it possible to preserve and restore the beneficial properties of groundwater and soil; to provide environmentally safe and effective pest control; to remotely monitor compliance with the certification requirements of organic agriculture.

The transformation of agriculture in the Republic of Uzbekistan includes the digitalization of the following areas of production:

- Crop production, primary processing, accelerated selection and genetics.
- Open and protected ground vegetables, greenhouse industry.
- Fruit and berries, processing and storage technologies.
- Aquaculture, fish farming, processing technologies.
- Poultry and livestock breeding, nutrition, accelerated selection and genetics.

The further automation of processes at all stages of the production cycle represents a higher level of digital integration, which affects the most complex organizational changes in business, however, their implementation can dramatically affect the profit and competitiveness of products and the company as a whole. Integrating the resulting data with a variety of smart IT applications that process it in real time implements a revolutionary shift in decision making for a farmer by providing multiple factor analysis and the rationale for further actions. Based on scientific calculations, the information system is able to create recommendations for the processing and care of plants or instructions for automatic execution by robotic equipment. For the first time in the history of agriculture, a farmer will be provided with the possibility to control natural factors, to design accurate business processes, and, in addition, to predict the result with mathematical exactness.

General data from various participants in the production chain, collected in one place, makes it possible to obtain information of a new quality, find patterns, create added value for all involved participants, apply modern scientific processing methods and, based on them, to make the right decisions that minimize risks, improve the business of manufacturers and customer experience.

As an example, work [30] provides a detailed description of the automated farm management system of the Republic of Uzbekistan, which is the core of the 'Farms of the Republic of Uzbekistan' information system [31] and allows solving the following tasks:

- Planning programs of agrotechnical measures for specific fields on which crops will be grown.
- Determining control parameters, the time of conducting operations, their characteristics and reproduction conditions.
- Correcting the design information base according to new ideas about processing technology.
- Issuing reasonable recommendations.

At that, data mining methods, such as pattern recognition, description space dimensionality reduction, modelling, and regression analysis to predict final results, play a special role in the system operation.

The work [31] provides a block diagram of the information system of the agricultural sector of the Republic of Uzbekistan.

4 Discussion

Today, the prospects for the development of information technology in agriculture are unusually high. Some Russian agro-industrial complexes are already successfully using new farming technologies. At the moment, they include programs for calculating and optimizing feed rations and feed mixtures for various animals, software products for diagnosing diseases of animals and crops, information systems for automating operational accounting, animal breeding programs, geographic information systems, accounting information systems that take into account industry specifics, and integrated enterprise management systems.

The introduction of modern information technologies in agricultural production involves the constant enrichment of information from various external sources (for example, via the Internet) from almost anywhere in the area at any time. Getting data about certain weather forecasts can be available to farmers throughout the day. This allows a more rational and efficient use of various chemical plant protection products, and also significantly reduces the risk of environmental pollution.

The information system proposed in [31], considered as an integral part of the automation complex of the agricultural sector, has been implemented in more than 250 farms in Uzbekistan. The next step in solving the problem under study is the introduction of automated decision-making systems [9].

5 Conclusion

The role and tasks of automation of the agricultural sector, as well as the prospects for the use of information technology in the agricultural sector, have been determined. The opportunities for modernizing the industry are enormous. The food security of the country and the development of export potential turn agriculture into a high-tech industry that can not only provide food for the country itself, but also for many countries of the world, as well as create opportunities for the introduction of new innovative developments that did not exist before, stimulate the adoption of managerial decisions that can provide the population with high-quality and safe products.

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