Issues of digitalization of machine and tractor fleets in agriculture

Sayyora Kulmatova[1*], *Ochildi* Khatamov[2], and *Dilbar* Yusupova[1]

[1]Tashkent State Instituty of Economics, Tashkent, Uzbekistan
[2]Termiz State University, Termiz, Uzbekistan

Abstract. The article describes an intelligent machine and tractor fleet in agriculture. The article also describes smart technologies that facilitate participants' work in agricultural management and maintenance systems in machine and tractor fleets.

1 Introduction

There is a need to create a digital platform for the agro-industrial complex as an important component of the modern digital economy. As a result, to develop and develop a digital platform for the agro-industrial complex, the issue of developing new digital ones, including technologies and innovative business models, is being considered. The goal is to radically increase the efficiency of agricultural and agro-industrial enterprises through the widespread introduction of a digital platform as a service model.

In the Decree of the President of the Republic of Uzbekistan No. PP-4022 dated November 21, 2019 "On measures to further modernize the digital infrastructure for the development of the digital economy", special attention was paid to the use of infrastructure. The tasks of implementing targeted projects on the basis of public-private partnerships for introducing modern information and communication technologies in agriculture and creating technological conditions for introducing "smart agriculture" technologies were also specified.

The transition of the country's agro-industrial complex to digital technologies is important for ensuring competitiveness. Today, two main aspects of using digital technologies in agriculture can be distinguished - increasing efficiency and reducing losses. In agricultural production, about 40% of products are lost from cultivation to processing, and the remaining 40% are lost during processing, storage, and transportation. In addition, a large proportion of losses are associated with natural conditions, and only 25–30% of agricultural production results are considered anthropogenic [1-4].

First of all, an important role in digitalization is played by new models of economic behavior of markets - the creation of digital platforms and ecosystems. The use of modern technologies in the "intellectualization" of agriculture allows: to preserve and restore the beneficial properties of groundwater and soil, ensuring environmentally sound and efficient pest control and remote monitoring of compliance with the certification requirements of

*Corresponding author: squllmatova@mail.ru

organic agriculture. As a result, the potential of agriculture, including production, will expand, and the efficiency of using agricultural resources will increase [5-7].

The scale of production and supply in all areas of agriculture is based on the application of modern technologies with the potential to increase efficiency and the successful integration of several technologies that are mainly climate-friendly and improve the environment. Expanding the use of smart technologies to change agricultural systems should also be a priority. Consider a fully automated machine-tractor park intelligent system for a machine and tractor fleet that provides intelligent solutions using IoT technologies. It shows the architecture of a new service model based on an interactive platform for managing machine-tractor parks and services - information technologies and tools (Fig. 1).

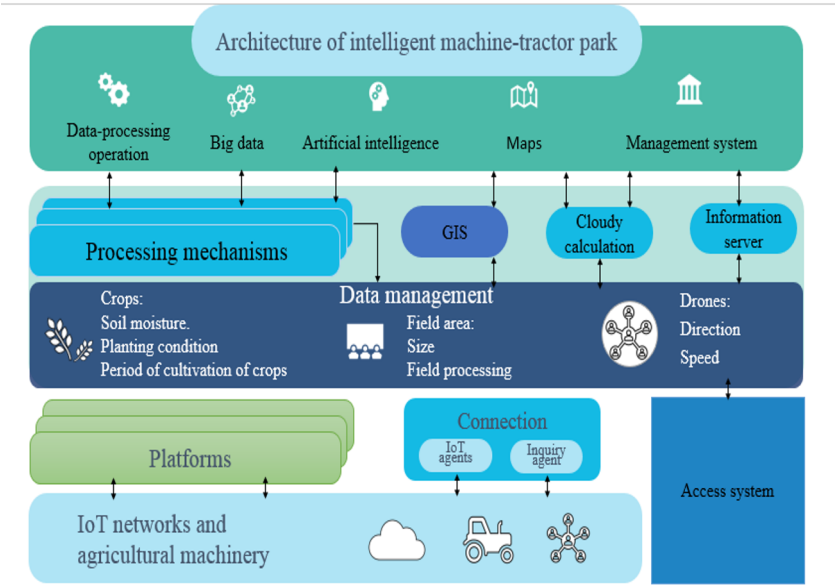

Fig. 1. Intelligent machine-tractor park architecture

This will strengthen the machine and tractor fleet's ability to innovate, maintain and manage. At the same time, digital technologies offer great opportunities for the smart park. The solutions used include the intelligent machine-tractor park management system.

2 Methods

Access control on the Smart MACHINE-TRACTOR PARK platform, daily accounting of work, costs, management of the location and visitors of the machine-tractor park, identification of general patterns of changes in the technical condition of tractors and machines, maintenance of tractors, troubleshooting of tractors during operation, vehicle diagnostics, organization of maintenance and diagnostics of tractors, supplying machine-tractor park with fuels, lubricants, and other operating materials, organizing the storage of machines and tractors, organizing agricultural transportation, mechanizing loading and unloading operations, servicing, servicing customers of various sizes, identifying needs, and other application subsystems. The introduction of intelligent machine-tractor parks will improve the overall efficiency and service level of the machine and tractor fleet through

Internet of Things technologies, cloud technologies, and smart card technology. Smart park solutions always form a system of relationships between the functional divisions of the MACHINE-TRACTOR PARK and various client enterprises.

The Smart Parking model consists of (a) a parking module, (b) a user interface, (c) a communication module, (d) a parking manager, (e) space management components [4], including navigation equipment inside and outside parking lots, means of payment and monitoring of parking spaces. It uses ultrasonic sensors, optical sensors, and blocks of surveillance cameras. This system's main advantage is identifying state numbers at the entrance and exit from parking lots, as well as visual control of the current situation in a particular parking lot [5]. Smart Parking uses image processing techniques to determine the vehicle's registration number, and it also has security features such as fire and gas warning, which ensures that the autonomous door opens and closes upon entry. Raspberry Pi is a control unit that completely controls the system's operation and processes data [6-10].

3 Results and discussion

The main goal of creating a smart auto-tractor fleet is to further improve the internal capacity of the park through digital technologies and increase the service capacity of the park to encourage entrepreneurial innovation, strengthen the fleet management system, and integrate various enterprise resources. It uses a wide range of technologies such as IoT sensors, devices, GIS (geographic information system) services, unmanned aerial vehicles, and digital tractors that provide real-time data to systems that help control the production line and support decisions. These technologies ensure the maximum efficiency of service processes. GIS technology supports landscape systems integrated into a digital mapping information system in monitoring agricultural land use. Unmanned aerial vehicles are widely used to assess the quality of the crop and determine its damage or death, determine the exact area of affected crops, sow seeds (special systems programmed to scatter seeds on prepared soil), identify deviations and distortions in agricultural work, etc. more (Fig. 2).

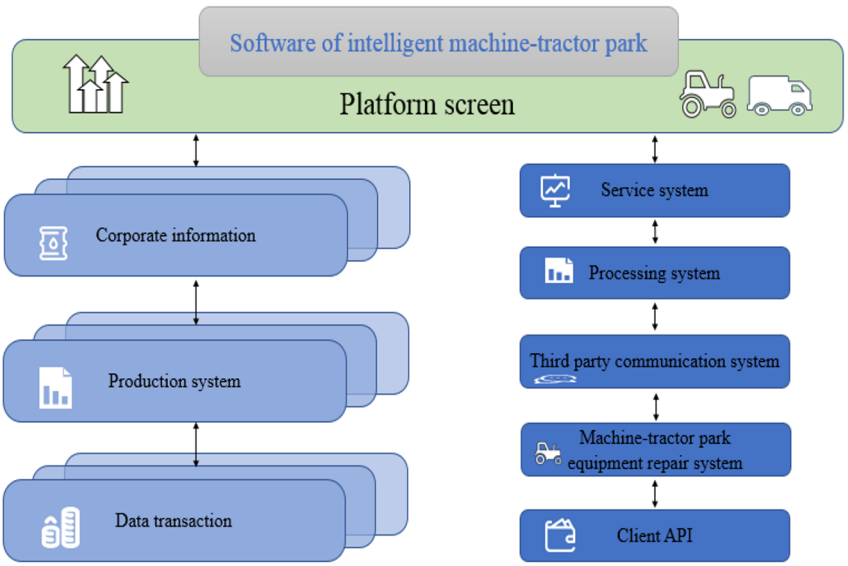

Fig. 2. Machine-tractor park intelligent software

Smart machine-tractor park, as an open source platform, provides a standard way to develop and integrate smart farming solutions. The smart park combines the data center with application subsystems as a platform. It combines data from drones, sensors, and other devices, as well as vertical smart solutions and information systems. Alternative IoT platforms can be used for this purpose. The intelligent machine and tractor fleet is installed on the interface using software adopted as a standard communication tool (Fig.3).

General intelligent park management systems can be developed at the standard level of contextual data management. Data access control allows you to identify and enforce system rules.

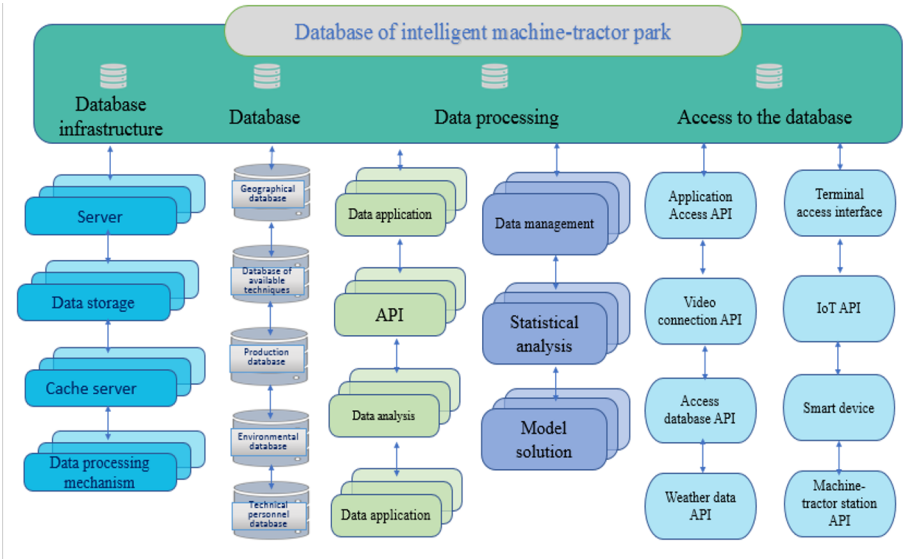

Fig. 3. Machine-tractor park smart database.

The platform provides innovative vertical solutions based on the deployment of IoT in the cloud, along with real-time big data, artificial intelligence tools, and dashboards, with the ability to integrate these new solutions from different sides. Contextual data from agricultural enterprises are combined and re-edited to create a holistic picture of what is happening there. It is processed by big data processing programs to extract the necessary data from the collected data or to manage movements. Complex event processing can be integrated using technologies such as artificial intelligence or machine learning (Fig. 4).

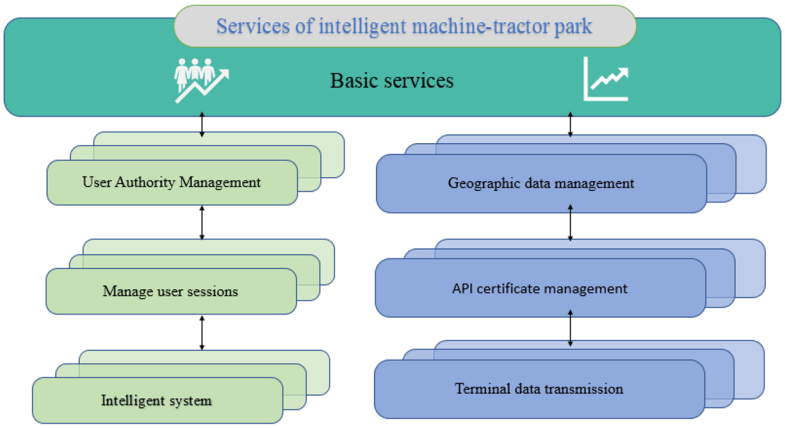

Fig. 4. Machine-tractor park Intelligent Services

System security, user access rights, and a set of interactions between the consumer and the platform over some time are provided by smart parking services.

In the system of intelligent machine and tractor fleet, part of the electricity is obtained from a set of solar panels installed on the roof of the enterprise building. This complex provides all stations, including most electricity needed for the entire system. The smart park provides easy access for users by allowing them to export relevant data as needed.

4 Conclusions

In conclusion, we note that the functions of an intelligent machine and tractor fleet include environmental monitoring, i.e., air temperature and humidity, sunlight, soil temperature, the use of cameras, tablets, wireless gateways in determining nutritional value, the use of temperature and humidity sensors in determining soil moisture. , plant growth monitoring and soil moisture detection can include video surveillance, remote control through the cloud management platform, intelligent decision making, expert guidance, and use in application applications (Fig. 5).

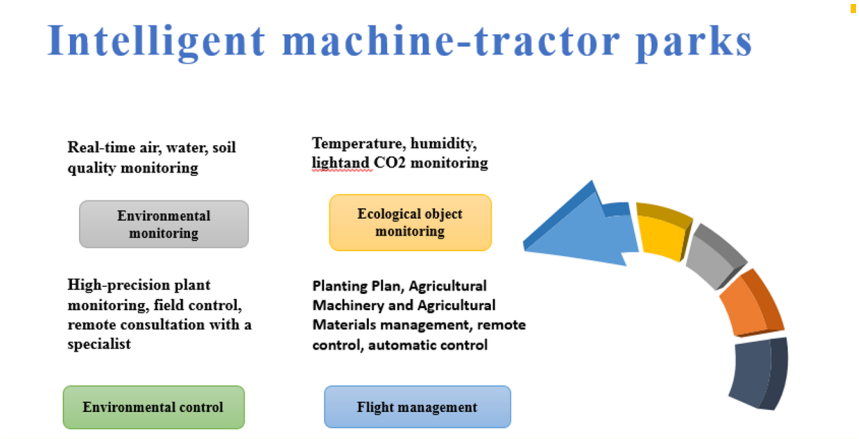

Fig. 5. Intelligent functions of the Machine-tractor park.

The innovative technology makes it possible to increase yields and reduce production costs through more efficient use of resources: agricultural machinery, fuels and lubricants, seeds, plant protection products, and fertilizers.

References

1. Dibirov A. Approaches to Modeling the Machine and Tractor Fleet of an Agricultural Organization in the Conditions of Digitalization. In Agriculture Digitalization and Organic Production: Proceedings of the Second International Conference, ADOP 2022, St. Petersburg, Russia, pp. 339-350. Singapore: Springer Nature Singapore. (2022).
2. Iovlev G., Goldina I., Saakyan M., and Zorkov V. Digitalization of technical service: formation and development prospects, impact on the efficiency of agricultural production. In International Scientific and Practical Conference "Digital agriculture-development strategy"(ISPC 2019), pp. 31-35. Atlantis Press. (2019).
3. S.B. Ognivtsev. The concept of a digital platform for the agro-industrial complex // International Agricultural Journal. 2018. No. 2.
4. Jiri Hanzl. Parking information systems and smart technologies. The program is used in urban areas and multi-storey car parks. LOGI 2019 - Horizons of autonomous movement in Europe. (2019).
5. M. Khalid, K. Wang, N. Aslam, Y. Cao, N. Ahmad, M. Khurram Khan, From smart parking towards autonomous valet parking: A survey, challenges and future Works,Journal of Network and Computer Applications,Vol. 175, (2021).
6. M. Venkata Sudhakar, A.V. Anoora Reddy, K. Mounika, M.V. Sai Kumar, T. Bharani, Development of smart parking management system, Materials Today: Proceedings, (2021).
7. Elkin O. V., and Savchenko O. F. Automated assessment system of energy parameters of the tractor fleet. In IOP Conference Series: Earth and Environmental Science, Vol. 957, p. 012006. IOP Publishing. (2022).
8. Alt V. V., Savchenko O. F., and Elkin O. V. Digital technology of assesment the power capacity of tractor fleet of an agricultural enterprise. (2019).
9. Abuselidze G., Gorovij V., Mishchenko D., Bilyak Y., and Nehoda Y. Economic and Ecological Aspects of the Application of Digitalization of Agriculture. In XV International Scientific Conference "INTERAGROMASH 2022" Global Precision Ag Innovation 2022, Vol. 1, pp. 1391-1402. Cham: Springer International Publishing. (2023).
10. Belikova I. P., Chernobay N. B., Kron R. V., Zhukova V. A., and Dolgopolova A. F. Digitalization in Agriculture-A New Step in the Development of Agro-industrial Complex. In Smart Innovation in Agriculture (pp. 65-73). Singapore: Springer Nature Singapore. (2022).