The American Journal of Engineering and Technology
(ISSN – 2689-0984)
Published: December 22, 2021 | **Pages:** 69-75
Doi: https://doi.org/10.37547/tajet/Volume03Issue12-10

IMPACT FACTOR
2021: 5. 705
OCLC - 1121105677

Journal Website: https://theamericanjournals.com/index.php/tajet

The Fourth Industrial Revolution And Consequential Agricultural Machinery Market Changes

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ABSTRACT

This publication examines the gradual introduction of digitalization in the agricultural sector, with the help of which it is aggravated by the increased concentration of the market, which becomes noticeable in digital industries. As a result, the benefits of any increase in labor productivity may go to the owners of a small number of companies, and the structure of income distribution may be distorted to an extent that is incompatible with social stability.

KEYWORDS

Precision Farming, Parallel Driving, Tractor, Mechanization, Mechanical Engineering, The Fourth Industrial Revolution.

INTRODUCTION

The modern world as we know it has largely become possible thanks to the revolutionary changes taking place with industry. Structural transformation is the core of economic development. Without strengthening their productive capacities and the flow of resources to more productive sectors, countries will not be able to meet the requirements of the 2030 Agenda for Sustainable Development. There are many examples in history when structural transformations have led to an increase in labor productivity, employment growth and higher wages, creating conditions for a more equitable distribution of income. However, the fourth industrial revolution, driven by advanced technologies such as artificial intelligence and robotics, could change the rules of the game for countries embarking on

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the path of industrialization. In conditions of displacement of labor from sectors with low productivity, the growth of automation can narrow the opportunities to find decent work and put downward pressure on wages. This may be compounded by increased market concentration, which is becoming noticeable in digital industries. As a result, the benefits of any increase in labor productivity may go to the owners of a small number of companies, and the structure of income distribution may be distorted to an extent that is incompatible with social stability.

The fourth industrial revolution refers to the growth of automation and data exchange in the field of production, which is exactly what is happening now and leads to the creation of intelligent and interconnected production systems. This is one of the main driving forces of the Fourth Industrial Revolution. The Fourth Industrial Revolution is associated with the digitalization of Internet-based production, the development of the industrial Internet of Things, the collection and analysis of big data, new forms of interaction between people and machines, the improvement of the use of digital instructions thanks to robotics and three-dimensional (3D) printing.

Some forms of modern innovation ignore the social and environmental aspects of sustainable development and exacerbate inequality. The important question facing the developers of science, technology and innovation policy today is not only how to stimulate more innovation, but also how to encourage the right forms of innovation in the interests of building more inclusive and equal societies, while preventing harmful innovation. Growth-stimulating structural transformation and maintaining the country's competitiveness are impossible without a successful innovation policy.

Currently, the Republic of Uzbekistan is also actively developing the fourth industrial revolution in industry and is supported by the head of state.

President Shavkat Mirziyoyev signed a decree "On the approval of the Digital Uzbekistan 2030 Strategy [1] and measures for its effective implementation." A wide range of activities is planned as part of the implementation of the strategy.

During the digital transformation of regions and industries in 2020-2022, it is expected:

- Increase from 78% to 95% of the level of connection of settlements to the Internet, including by increasing up to 2.5 million broadband access ports, laying 20 thousand km of fiber-optic communication lines and the development of mobile communication networks;
- Implementation of over 400 information systems, electronic services and other software products in various areas of socio-economic development of the regions;
- Training 587 thousand people in the basics of computer programming, including by attracting 500 thousand young people within the framework of the "One Million Programmers" project;
- Implementation of over 280 information systems and software products for automation of management, production and logistics processes at enterprises of the real sector of the economy;
- Consolidation of universities in the regions to improve the digital literacy and skills of hakims, employees of government agencies and organizations, training them in information technology and information security, training 12 thousand of their employees in information technology.

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In fact, the improvement of production is not new the first industrial revolution took place 3 centuries ago, the appearance of steam engines to switch people from manual labor to machines. The second is the emergence of electricity and mass conveyor production 3 the industrial revolution calls the digital beginning of the half of the 20th century the creation of computers, and subsequent information technology. The fourth is the introduction of cyber physical systems into production.

The Fourth Industrial Revolution is the reaction of our main industries to the dynamics of markets and economic interaction that allows us to optimize production in real time. With the introduction of the fourth industrial revolution, the boundary between the physical and digital and biological spheres is erased, robots, drones, smart horada, smart fermi, artificial intelligence system connects into one network, communicate with each other in real time, It adjusts itself and learns from new models of behavior, they will be able to build production with a smaller number of errors, interact with manufactured goods and, if necessary, adapt to new consumer details. This era means more and more automation and intellectualization of all industrial processes from digital design, digital copy creation to individualization of approach to customer service. The agricultural complex is one of the main directions of Uzbekistan's industry. The main effect of the introduction of the fourth industrial revolution is labor productivity, cost optimization, high-quality cheese, cost reduction, food safety and nailed. In the first example of what we can say, Uzbekistan began to build smart greenhouses, began to use precision farming systems and others.

At the end of the last century, the term "precision farming" began to be actively mentioned in agriculture. In various sources, you can also find its name as coordinate or precision (precision - from the English exact). The introduction of precision farming requires the installation of special equipment on tractors, sprayers, combines, allowing the normal functioning of the following systems and works:

- A positioning system that allows you to determine the location of any object on the earth's surface with high accuracy;
- A parallel driving system that allows you to carry out field work (plowing, chiseling, malovanie, sowing, row-to-row processing, fertilization and pesticides, harvesting) with maximum accuracy and a minimum of "unnecessary" movements. Its important advantage is also the possibility of carrying out agrotechnological operations at night with the same efficiency and accuracy as during the day;
- Geographic information system, that is, software that integrates all available data in different formats, in layers and from various sources, including data from various sensors and expert assessments of specialists;
- Equipment for variable dosing (integrated into a spreader, seeder, cultivator-plant feeder, sprayer).

As foreign practice shows, with precision farming, with the help of rational use of each square meter of the field, it is possible to significantly increase the efficiency of work, save material resources and reduce the negative impact on the environment. This requires modern technology, an on-board computer, land measurement systems, devices that detect the heterogeneity of fields, the required amount of fertilizers, as well as automated calculation of plant growth and development, yield.

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Modern information and communication technologies make it easy and scientifically sound to manage crops at the field level. Decision-making in the field of modern agricultural production requires special equipment and machines that would support the technology of variable application of VRT (English Variable Rate), for example, variable dosing of seeds or differentiated application of fertilizers and pesticides for plant protection.

Satellite technologies have been very timidly integrated into agriculture. For a long time, the potential of satellite systems simply did not know how to apply. Today, global positioning receivers installed on many tractors, combines and other mobile means used in agricultural production allow you to control the movement of agricultural machinery or any other mobile means and plan their work. The role of parallel driving technology is especially great in this.

Parallel driving is the most affordable and widespread precision farming technology. And after mapping - the first in the order of implementation. The popularity of this technology is based on the ability to accurately perform agrotechnical operations, and it does not require large investments, the technique is not technically complicated, the training of machinists-operators is fast, the result is noticeable immediately after the work is done.

This system allows you to carry out field work (plowing, chisel-growing, cropping, sowing, inter-row cultivation, fertilization and pesticide application, harvesting) with maximum accuracy and a minimum of "unnecessary" movements. Its important advantage is also the possibility of carrying out agrotechnological operations at night with the same efficiency and accuracy as during the day. It is difficult to overestimate the importance of such an opportunity in relation to the meteorological conditions of the republic, when in the season of soil preparation and sowing due to adverse weather conditions, there is only a small "window" of 1-3 days for field work, of which literally not a single minute can be lost.

The parallel driving system is based on the use of a satellite navigation signal. To do this, the equipment is equipped with parallel driving system devices, which include:

- Navigation receiver;
- Display;
- The system can be equipped with a thruster or autopilot.

The operation of the system is accompanied by software.

The thruster is designed for automatic driving of tractors, combines, or other self-propelled agricultural machinery by signals coming from the control controller (Fig. 1). Driving accuracy (from 30 cm to 2 cm) depends on the type of GPS receiver.

Currently, there are three types of accuracy: submeter (from 30 centimeters or more), decimeter (7-15 centimeters) and centimeter (up to 2-2.5 centimeters). The latter two types are most attractive to farmers. Along with the type of accuracy, two types of signals are practiced – paid and free. When using a free GPS signal, the movement of the machine-tractor unit across the field is carried out with an accuracy of up to 30 cm, and when working with a paid signal, the accuracy reaches 2-2.5 cm.

When using a paid signal, the area of untreated or twice-treated sections of the field, the idling length of the machine-tractor unit and the width of the turn lane are radically reduced. All this leads to a significant reduction in material resources - fuel, seeds, fertilizers, herbicides and pesticides.

The advantage of the parallel driving system is that it does not require large financial costs, like other elements of precision farming. From a technological point of view, it is simpler and more affordable, and the effect of its use is instantaneous. In addition, the system pays off very quickly - literally in one or two seasons.

Fig. 1. Conducting field work with maximum accuracy

The parallel driving system is divided into auxiliary and automated steering systems.

Auxiliary steering systems, relying on the work of positioning systems (GPS), tell the driver-operator where to go at the moment. Based on these tips, the operator-operator must manage the machine-tractor unit independently.

The use of automated steering systems makes it possible to simplify a number of tasks related to the management of agricultural machinery, and thereby relieves the operator from performing monotonous actions and reduces the influence of the so-called "human factor" [2].

Automated steering systems (autopilot) fully control the steering wheel, which allows the operator to release the steering wheel free directly during agrotechnological operations. Attention may be focused on the operation of other devices not directly related to steering, not related to this agrotechnological operation. Intelligent guidance systems have various control patterns in their arsenal, and they can be used with the two previous systems.

Autopilotation differs from parallel driving in that the signal of deviation from the specified trajectory, received by the GPS receiver and processed by the navigation controller, is introduced by means of the control valve directly into the hydraulic control system of the tractor wheels, bypassing the steering device, and thereby eliminating inertia and steering play. In addition, a special wheel angle sensor is installed on the tractor. With such a signal flow scheme, the maximum accuracy (deviation ± 2 cm) of the movement of the machine-tractor unit along the route is achieved without the intervention of the operator-operator.

For parallel driving and autopilot driving, the following equipment is used on the tractor:

- The receiver supports various options for correcting GPS signals, the use of which allows you to ensure the accuracy of the movement;
- The LED panel (monitor) graphically shows the current position of the machine-tractor unit and provides the driver-operator with additional information when turning or driving along a curved trajectory. It has a graphic display with the ability to read data in bright sunlight;
- The field computer with software is a data management system used for navigation, automatic driving, record keeping, field survey, areal survey, variable metric applications;
- The controller, based on processing data from the GPS receiver and internal sensors at rest and operating along 6 axes, transmits commands to the control system. There are also controllers combined with a GPS receiver;
- The wheel steering angle sensor is used for continuous feedback with the control system of the machine and tractor unit;
- The hydraulic valve receives electrical signals from the controller and converts them into hydraulic signals, which the system uses to keep the machine-tractor unit on a given course;
- Thruster provides parallel driving with an accuracy of 10 cm;
- The base station transmits the corrections of the GPS position to the GPS receiver of the machine and tractor unit via radio communications or a GSM modem to determine coordinates with high accuracy (error less than ± 2 cm).

At present, the production of tractors under the Zamin brand is being established in the republic at the Tashkent Agricultural Machinery Plant (Fig. 2), for the first time equipped with a parallel driving system developed at the Design and Technological Center for Agricultural Engineering LLC together with the Moscow representative office of "Trimble", which includes [3]:

- Monitor GFX-750 (s/n 5722200124);
- Receiver navigation controller Nav900 (s/n 5722400156);
- Trimble thruster;
- Electric motor SAM 200 (s/n 5825M66036);
- A set of cable harnesses and mounting plates and brackets.

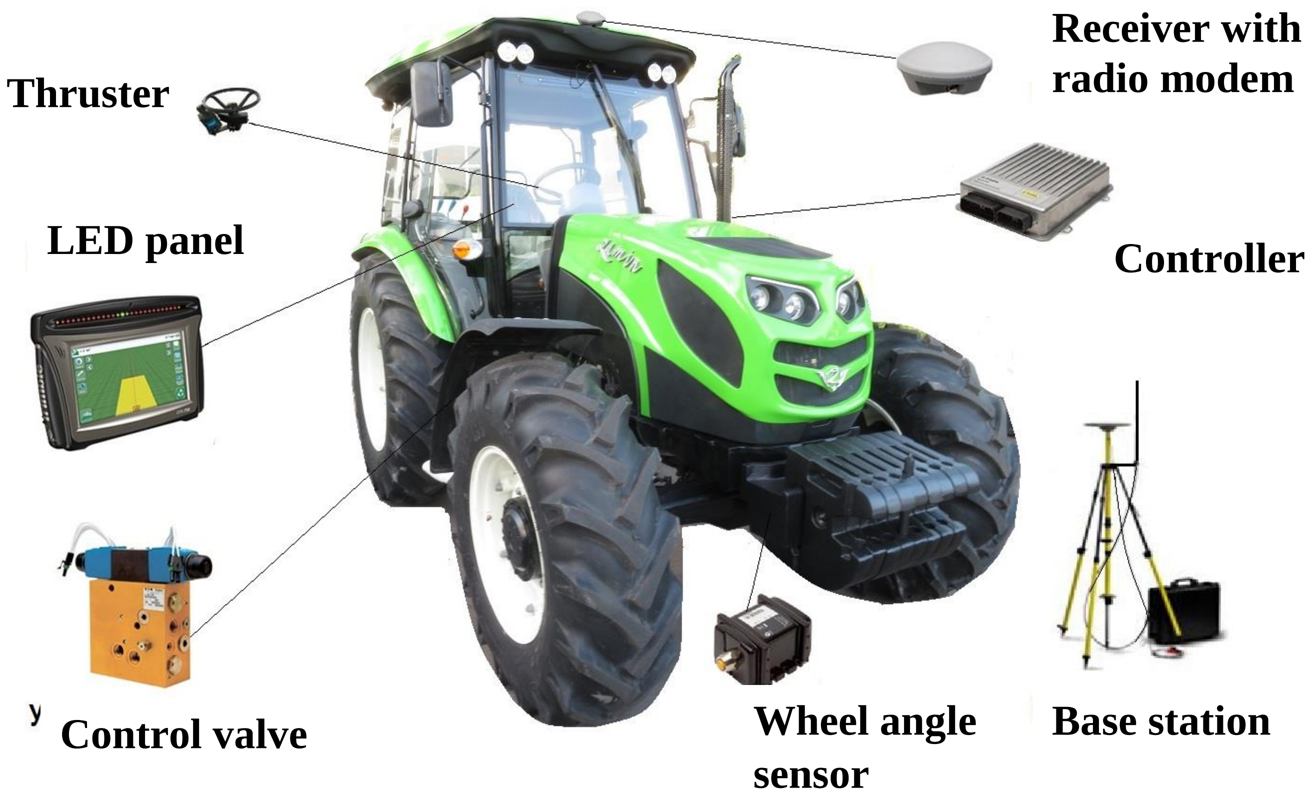

Fig. 2. Automated steering systems

This tractor will be the first swallow in the introduction of the concept of precision agriculture in the republic in terms of the parallel driving system and a set of basic machines for agricultural field work is being developed for it. In the future, the issue of introducing an automated steering system, i.e. autopilot, is also being considered.

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