

УДК 338.436: 330.341.1

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DOI: 10.32702/2306-6792.2025.1.26

THE ROLE OF INNOVATIVE TECHNOLOGIES IN SHAPING ORGANIZATIONAL AND ECONOMIC RELATIONS IN THE AGRO-INDUSTRIAL COMPLEX

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РОЛЬ ІННОВАЦІЙНИХ ТЕХНОЛОГІЙ У ФОРМУВАННІ ОРГАНІЗАЦІЙНО-ЕКОНОМІЧНИХ ВІДНОСИН В АГРОПРОМИСЛОВОМУ КОМПЛЕКСІ

In the context of the war in Ukraine, the agro-industrial complex has faced new challenges that affect resource availability, infrastructure preservation, and the stability of economic relations. This article examines the role of innovative technologies that help reduce agricultural enterprises' dependence on traditional supply chains, which have been damaged due to the hostilities. Production adaptation and technology implementation allow for food security under unstable conditions. The adoption of innovations is also considered a way to strengthen the resilience of the agro-industrial sector to war-related risks, supporting the country's economic recovery.

In the context of growing global competition, agro-industrial enterprises face the need to quickly adapt to new market conditions. The use of innovative technologies, such as automation, digitalization, precision agriculture, digital platforms, and artificial intelligence, has become a key factor in enhancing the efficiency and competitiveness of agro-industrial enterprises. This article examines how these technologies contribute to optimizing production processes, reducing operational costs, and improving management decisions.

It has been established that the effective development of agricultural enterprises requires the implementation of innovative technologies that change economic relations not only at the level of individual enterprises but also at the macroeconomic level, creating prerequisites for new forms of cooperation and partnership. The development of innovative technologies in the agro-industrial complex not only increases production efficiency but also promotes sustainable development and environmental safety, thereby reducing the negative impact on the environment, which is an important aspect of modern agribusiness. The impact of innovative technologies on interactions among market participants, including suppliers, consumers, and government institutions, strengthens economic relations and partnerships between large agro-enterprises and small farmers.

Innovative technologies contribute to the creation of more flexible and resilient organizational and economic connections, ensuring effective resource management and optimization of production processes. The implementation of digital platforms allows agro-industrial enterprises to improve communication with partners, suppliers, and consumers, providing transparency and timely data exchange. Automation of processes helps reduce costs and improve product quality, fostering long-term trust and partnerships among market participants. Innovations in logistics management ensure efficient transportation and storage of products, minimizing losses and reducing distribution costs. Through these approaches, enterprises establish resilient interaction networks that enhance their competitiveness and adaptability to market changes.

В умовах війни в Україні, агропромисловий комплекс зіткнувся з новими викликами, що впливають на доступність ресурсів, збереження інфраструктури та стабільність економічних відносин. У статті розглядається роль інноваційних технологій, які допомагають зменшити залежність агропідприємств від традиційних логістичних ланцюгів, що зазнали пошкоджень унаслідок бойових дій. Адаптація виробництва та впровадження технологій дозволяють забезпечити продовольчу безпеку в умовах нестабільності. Впровадження інновацій також розглядається як спосіб посилення стійкості агропромислового сектору до ризиків, спричинених війною, що сприяє економічній відновлюваності країни.

В умовах зростаючої глобальної конкуренції підприємства агропромислового комплексу стикаються з необхідністю швидко адаптуватися до нових умов ринку. Використання інноваційних технологій, таких як автоматизація, діджиталізація, точне землеробство, цифрові платформи та штучний інтелект, стає ключовим чинником підвищення ефективності та конкурентоспроможності підприємств АПК. У статті досліджено, як ці технології сприяють оптимізації процесів виробництва, зниженню операційних витрат та поліпшенню управлінських рішень.

Встановлено, що для ефективного забезпечення розвитку аграрних підприємств необхідно впровадження інноваційних технологій, що змінюють економічні відносини не лише на рівні окремих підприємств, а й на макроекономічному рівні, створюючи передумови для нових форм кооперації та партнерства. Розвиток інноваційних технологій у агропромисловому комплексі не лише підвищує ефективність виробництва, а й сприяє сталому розвитку та екологічній безпеці, що сприяє зменшенню негативного впливу на навколишнє середовище, що є важливим аспектом сучасного агробізнесу. Вплив інноваційних технологій на взаємодію між учасниками ринку, включаючи постачальників, споживачів і державні інституції, сприяє зміцненню економічних відносин і партнерства між великими агропідприємствами та малими фермерами.

Інноваційні технології сприяють створенню більш гнучких і стійких організаційно-економічних зв'язків, забезпечуючи ефективне управління ресурсами та оптимізацію виробничих процесів. Впровадження цифрових платформ дозволяє агропромисловим підприємствам покращити комунікацію з партнерами, постачальниками і споживачами, забезпечуючи прозорість і оперативний обмін даними. Автоматизація процесів допомагає знизити витрати і підвищити якість продукції, що сприяє довгостроковій довірі та партнерству між учасниками ринку. Інновації в управлінні логістикою забезпечують ефективне транспортування та зберігання продукції, що мінімізує втрати та знижує витрати на дистрибуцію. Завдяки таким підходам підприємства формують стійкі мережі взаємодії, що сприяє їхній конкурентоспроможності та адаптивності до змін на ринку.

Key words: innovation, entrepreneurial activity, organizational and economic relations, agricultural enterprises, innovative technologies.

Ключові слова: інновації, підприємницька діяльність, організаційно-економічні відносини, сільськогосподарські підприємства, інноваційні технології.

INTRODUCTION

The agro-industrial sector plays a key role in the economic development of all entrepreneurial entities. Its primary objectives include the marketing of produced goods, ensuring working capital for the sustainable renewal of business processes,

paying wages, fulfilling financial obligations, and achieving profitability. However, in practice, the efficiency of agro-industrial enterprises often significantly deviates from the national average, with many of these businesses failing to implement innovations and remaining unprofitable.

Agro-industrial activity requires the creation of a qualitatively new system of organizational and economic support for the innovative development of enterprises in the sector under competitive conditions. A modern strategy should incorporate new knowledge, technical and technological innovations in production, and up-to-date information. The outcome of such a strategy will be an increase in the economic efficiency of agro-industrial enterprises and an improvement in the social living standards of the population. The justified need for developing a strategy for the innovative development of these enterprises is driven by socio-economic transformation processes and the low efficiency of business entities' operations.

Enterprises operating under agro-industrial integration enjoy significant economic advantages. This necessitates the implementation of innovative, resource-saving production technologies and the production of competitive goods, which, in turn, contribute to enhancing the efficiency of the agro-industrial business.

ANALYSIS OF KEY STUDIES AND PUBLICATIONS

A significant contribution to the study of the general problems of the development and establishment of entrepreneurship, business, and innovation has been made by renowned foreign scholars, including R. Cantillon, J.-B. Say, A. Smith, D. Ricardo, A. Marshall, J. Schumpeter, F. Hayek, P. Samuelson, J. M. Keynes, and many others. Theoretical and methodological issues of reforming and innovatively developing components of the agro-industrial business, as well as evaluating the effectiveness of innovation processes in the agro-industrial complex (AIC), have been explored by prominent researchers such as V. Andriyuk, L. Antonyuk, V. Heyets, P. Haidutskyi, Yu. Danko, Yu. Lupenko, M. Lobas, M. Malik, B. Paskhaver, P. Sabluk, O. Shpykulyak, O. Shebanina, and Yu. Kormyshkin.

Despite the extensive coverage of issues related to the modern functioning of the agro-industrial sector in Ukraine and globally, the systemic innovative development of agro-industrial enterprises under wartime conditions requires deeper investigation. Particularly relevant are scientific-theoretical and methodological approaches to the organizational and economic support of enterprise development through the use of innovations and advancements in science and technology in production processes, management, and planning. Under wartime conditions, the implementation of modern information and communication technologies, resource conservation, the development of

market institutions, and state regulation and support become especially critical. All these factors underscore the relevance of the research topic.

The study aims to explore innovative solutions and technologies for conducting business under uncertainty caused by military aggression, as well as to justify organizational and economic measures that will contribute to increasing the efficiency and stability of agro-industrial enterprises' operations.

RESULTS OF THE STUDY

The modern economy, especially in times of war, is becoming increasingly innovative and flexible, with innovation playing a critical role in maintaining the economic stability of agro-industrial enterprises, restoring economic growth, strengthening competitiveness, and improving the standard of living for the population. Innovative solutions and technologies require adaptation to the new realities of conducting business, state regulation, and managing economic systems, particularly in crisis conditions.

The interaction between economic participants—households, enterprises, government institutions, research institutes, and non-governmental organizations—becomes crucial for the transformation of economic structures. This stimulates the creation of new industries, adaptation to current needs and challenges, enhancement of labor productivity, and improvement of economic resilience even in difficult conditions. The implementation of innovations helps ensure the rapid adaptation and recovery of key sectors, as well as create a foundation for future sustainable development.

The interaction between participants in economic systems contributes to the activation of the innovation process, the acceleration of their implementation, the improvement of production technologies, and the enhancement of overall productivity. Furthermore, such interconnections create conditions for the development of new business models, leading to changes in the economic structure. The introduction of innovative management methods in economic systems can become a defining factor in economic development and ensuring the long-term stability of society [4].

It is worth noting that innovative economic activity and its contribution to the development of economic systems remain a methodologically complex issue that has not yet been resolved within the framework of traditional economic theory. This is especially evident in the issue of classifying productive and unproductive labor. For example, classical economic theory, particularly in the

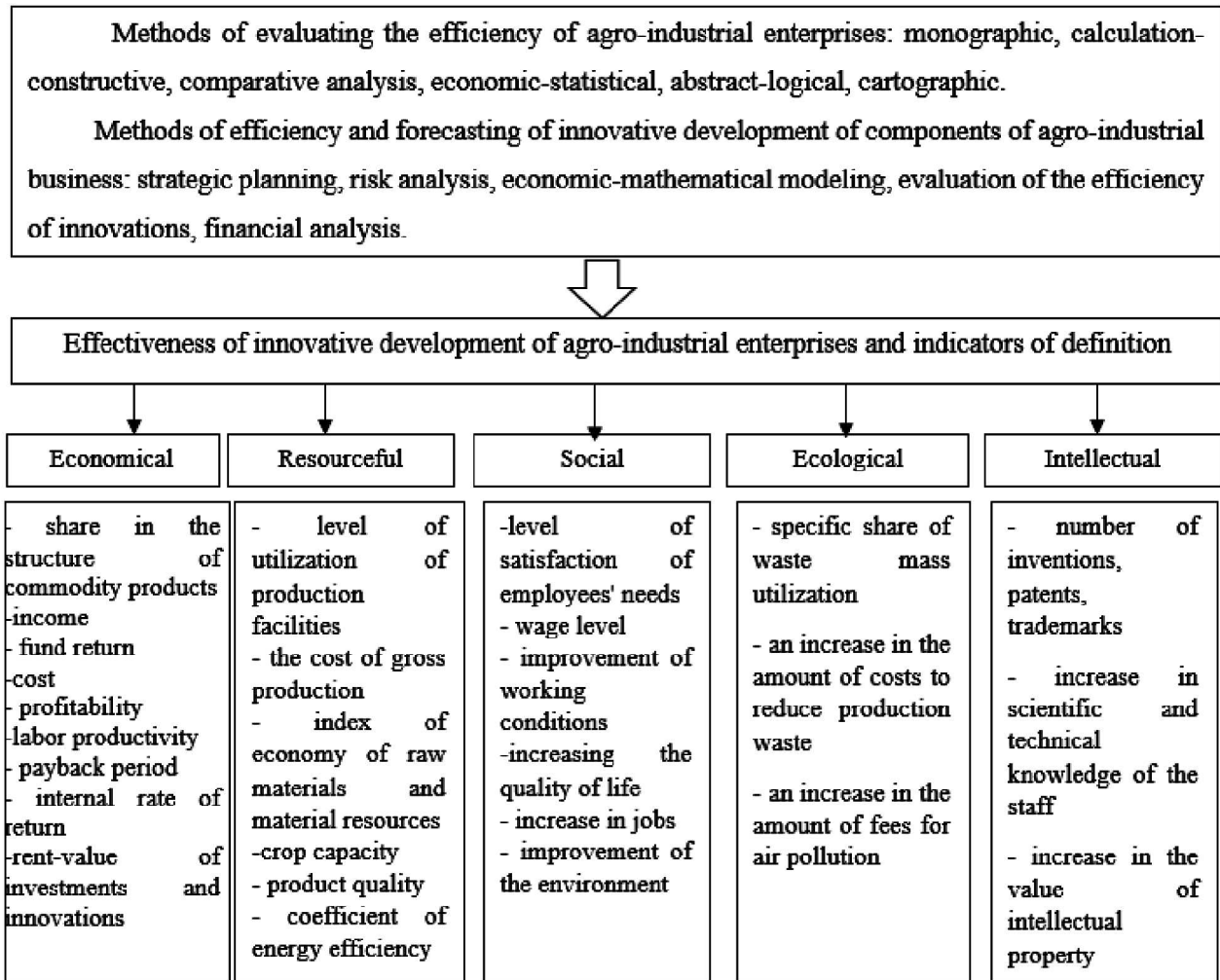


Fig. 1. The diagram of the comprehensive approach to evaluating the types of efficiency in the innovative development of agro-industrial enterprises

works of Adam Smith, focused on the creation of material goods as the primary criterion of productive activity.

However, this statement does not align with modern trends, where the importance of intellectual labor, intellectual property, and knowledge-intensive technologies is increasing. Today, it is the productive force of labor, particularly intellectual labor, that serves as a key factor in economic development, rather than the volume of physical labor input. Foreign experts indicate that modern knowledge-intensive products are 95% composed of intellectual components, while material costs account for only 5%. This highlights the importance of innovation and its growing role in the functioning and development of economic systems.

Innovations in economic processes form the foundation for increasing the efficiency of agricultural production and serve as the material basis for expanding production volumes. The introduction of innovations contributes to impro-

ving product quality, enhancing competitiveness, and reducing costs. Innovative activity provides the economy with a boost, leading to a shift in equilibrium and granting an active role to the economic mechanism. Without innovation, it is impossible to increase the level of productive forces or create the conditions for stable production development.

Moreover, innovative economic activity acts as an objective element of the economic system, shaping the mechanism of economic self-development and increasing its synergistic effects. It is a crucial element in the business operations of enterprises, as it is directly integrated into the economic mechanism, serving as a key factor in competitive struggles and the formation of economic equilibrium.

The systemic approach to evaluating the effectiveness of innovative development in agro-industrial sector enterprises (Fig. 1) is based on several key aspects. As shown in the figure, the

Table 1. Key Areas of Digital Innovation in the Agricultural Sector include:

Direction	Benefits of use
Cartography	- The use of modern electronic cartographic technologies allows agricultural enterprises to solve many standard problems. Thanks to these tools, you can conduct detailed soil analysis, use satellite images to estimate the NDVI index, create yield maps for different crops, determine the most productive areas, as well as monitor the dynamics of plant growth and predict future harvests.
Logistics solutions	- Today, there are many effective IT tools for logistics, designed to optimize routes for the collection and delivery of products from suppliers to a warehouse or other destination. The integration of automated logistics solutions in the work of agricultural enterprises helps to significantly reduce transportation time, save fuel, improve the quality of harvesting processes, reduce the risk of product spoilage and, as a result, reduce unproductive costs of companies.
Planning and analytics	Analytical systems contribute to effective planning of optimal rotation and placement of crops in the fields, which helps to increase yield and reduce the risk of losses. They make it possible to optimize the sowing and harvesting processes, reduce dependence on adverse climatic conditions and ensure the automation of such important processes as watering, application of fertilizers and pesticides. Thanks to this, farmers can control all stages of growing crops and adapt them to real conditions, reducing costs and increasing the efficiency of agricultural production.
Equipment monitoring	The implementation of GPS tracking for equipment monitoring allows agricultural companies to plan maintenance and repairs more effectively, preventing premature wear of equipment through a system of notifications and record keeping. This ensures timely control over the condition of specific parts and machines, which allows you to avoid unforeseen downtime. In addition, such systems provide an opportunity to create graphs of equipment utilization, as well as to plan its use taking into account safety. Data on the condition of fields and plantations can be quickly transmitted to the head office, which contributes to more accurate and quick management decisions.
CRM and HRM systems	The use of specialized management systems simplifies interaction with customers, partners and company personnel. Such systems help to personalize work with customers, developing individual strategies for each of them, which contributes to the growth of sales and strengthening of competitive positions in the market. In addition, they provide the ability to provide the necessary instructions to employees online, quickly respond to their requests and monitor their performance. This significantly increases overall productivity, reduces decision-making time and helps to quickly respond to changes in market conditions, ensuring flexibility and efficiency of the company's operations.
Analysis and management decision-making	Modern analytical systems significantly simplify the calculation of needs for seeds, plant protection products and fertilizers, which allows to optimize the use of resources and increase the efficiency of economic activity. They provide the possibility of automated cost accounting, help plan purchases and rationally allocate resources. In addition, these systems contribute to the management of the budget of the agricultural enterprise according to the principle of efficiency, which allows avoiding unnecessary expenses, improves financial planning and increases the overall economic stability of the company.
Monitoring in animal husbandry	Modern monitoring information systems significantly improve livestock management. They allow automating the planning of herd structure, which helps to effectively manage the number and characteristics of animals, which increases productivity and reduces risks. Veterinary activities such as vaccinations and preventive examinations can also be automated, ensuring that the necessary procedures are carried out in a timely and accurate manner. In addition, these systems allow you to automatically form food rations for animals, taking into account their individual nutrient needs, which improves the health and growth of the herd. The application of information systems to maintain an optimal microclimate on farms, such as temperature, humidity and ventilation control, also provides comfortable conditions for animals, which contributes to increased productivity and reduced stress.
Mobility	Thanks to round-the-clock access to data, mobile applications provide timely entry of relevant information into the system, which allows prompt decision-making and provides support at all stages of logistics processes. This increases work efficiency, reduces risks and ensures better coordination between all participants in the process.

Source: Summarized from the data [5].

assessment of the efficiency and competitiveness of agro-industrial businesses in different sectors and at the level of individual enterprises, as well as forecasting the innovative development of its main components, is crucial. The methodology includes the analysis of various types of efficiency, such as economic, technological, social, environmental, and intellectual.

This approach allows for a comprehensive assessment of the activities of the components of agro-industrial business and the adoption of necessary managerial decisions for the future. Among the modern directions of agricultural policy, a key focus is "Agricultural Policy in the Era of Technological Revolution 4.0."

The implementation of Fourth Industrial Revolution (Industry 4.0) technologies in the agro-industrial sector is crucial for increasing productivity and competitiveness in agriculture. This technological era involves the integration of modern digital and automated solutions into pro-

duction processes, aimed at improving productivity, efficiency, and sustainability in the agricultural sector [2].

The main elements of this concept are:

- Internet of Things (IoT): Through sensors, drones, and satellite technologies, producers can obtain detailed information about the condition of fields and plants, as well as manage resources such as water and fertilizers more efficiently.

- Artificial Intelligence and Data Analytics: AI is used for predicting crop yields, managing risks (e.g., related to weather conditions), optimizing production processes, and making decisions based on large volumes of data.

- Robotics and Automation: Automated machines, including robots for planting, harvesting, and servicing farms, reduce the need for human resources and increase the speed of land cultivation.

- Blockchain Technologies: Blockchain technologies are used to ensure transparency and

traceability of products in the supply chain. This is particularly important for agro-industrial enterprises, where product reliability and security are critical.

Therefore, "Agricultural Policy in the Era of Technological Revolution 4.0" is one of the most promising directions for development, combining cutting-edge technological advancements to achieve high results with lower costs. This not only eases the work of farmers but also creates opportunities for new forms of business management and the development of agro-industrial enterprises in the context of rapid globalization and digital transformation.

The development of innovations in the agricultural sector is the result of collaboration between breeders, biologists, technologists, and IT specialists. Recent years have brought significant changes to the conditions and efficiency of agro-industrial enterprises due to cutting-edge technologies. A key role in this is played by developments in the field of information technology, which help optimize the management, production, and marketing processes of agricultural products.

Currently, in the agricultural sector, eight key areas of IT innovations can be identified, including: automation of agricultural enterprise management, the use of satellite and unmanned technologies for field monitoring, the implementation of animal health monitoring systems, the development of technologies for optimizing resource use (such as water and fertilizers), and the application of big data analytics (Big Data) for predicting crop yields and assessing risks. These technologies open up new opportunities for increasing productivity and reducing costs, ensuring more sustainable and efficient development of agribusiness. The main areas of digital innovations in the agricultural sector can be presented in Table 1.

Digital innovations in the agricultural sector open up new opportunities for enhancing the efficiency and sustainable development of agribusiness. The use of modern IT solutions, such as automated management systems, the Internet of Things, drones, and satellite technologies, allows agricultural enterprises to optimize operations at all stages of production—from planning and monitoring fields to managing logistics and ensuring product safety. The implementation of big data analytics and artificial intelligence enables the prediction of crop yields, risk assessment, and the making of informed decisions, significantly reducing uncertainty in agribusiness.

Precision farming technologies, such as automated irrigation and fertilization systems, help reduce resource consumption and maintain

ecological balance while ensuring maximum crop yield. Blockchain technologies contribute to increasing the transparency of supply chains, which is crucial for quality control and product safety. Mobile apps for farmers enable real-time monitoring and decision-making, improving the efficiency of management processes.

All these innovations help agricultural enterprises not only increase productivity but also reduce costs, adapt to changing climatic conditions, and enhance competitiveness. Animal health monitoring systems and automated plant care solutions ensure better efficiency and control at every stage. The adoption of digital technologies has become a necessity for agribusinesses to remain competitive in today's market. As a result, digital innovations not only improve production efficiency but also make the agricultural sector more resilient to various challenges.

CONCLUSION

Innovations in the modern economy, especially in times of war, are a necessary condition for maintaining economic stability and the development of agro-industrial enterprises. The adaptation of innovative solutions to new realities and the operation of enterprises in conditions of uncertainty allow for maintaining competitiveness, increasing productivity, and quickly recovering. The interaction between government structures, enterprises, and scientific institutions stimulates economic transformations, creating new business models that contribute to growth and stability. Innovative technologies, both in production and management, improve the quality of goods and services, reduce costs, and optimize production processes.

Intellectual labor and knowledge-intensive technologies are becoming the main drivers of economic development, particularly in the agricultural sector, where innovations can significantly enhance the efficiency of agricultural production. Today, science and technology form the foundation for the competitiveness of products, ensuring the sustainable development of enterprises. Innovative economic activity stimulates not only the increase in production capacity but also the creation of conditions for long-term economic growth. It provides a synergistic effect, contributes to the growth of economic resilience, and opens up new opportunities for the development of enterprises and economic systems as a whole. Given current trends, innovations are a key factor in ensuring the efficiency and stability of economic activity.

In today's conditions, agricultural policy focused on the implementation of Fourth Industrial Revolution technologies is a key factor in the development of the agro-industrial sector. Technologies such as the Internet of Things (IoT), artificial intelligence, robotics, data analytics, and blockchain open up new opportunities for effective farm management. They allow for significant improvements in resource management, particularly water and fertilizers, as well as precise forecasting of crop yields and optimization of production processes. The integration of cutting-edge technologies enables agricultural enterprises to reduce costs, increase productivity, decrease the need for human resources, and improve product quality.

The development of such innovations contributes to the creation of new forms of management adapted to the conditions of globalization and digital transformation. Collaboration between specialists from various fields, such as biologists, technologists, and IT experts, enables the optimization of management, production, and marketing processes in agriculture. The implementation of satellite technologies, unmanned aerial vehicles, and animal health monitoring systems allows agribusinesses to effectively monitor the state of their resources and minimize risks. Thus, agricultural policy in the era of the Fourth Industrial Revolution is an important step toward enhancing the competitiveness of agribusiness, fostering innovation, and ensuring sustainable economic growth in the agricultural sector.

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- Стаття надійшла до редакції 09.12.2024 р.*