Interdisciplinary Description of Complex Systems 22(3), 296-304, 2024

ARTIFICIAL INTELLIGENCE AS A DRIVER OF SOCIO-ECONOMIC SYSTEM TRANSFORMATION IN UKRAINE

Sergiy V. Kovalevskyy*

Donbass State Engineering Academy
Kramatorsk, Ukraine

DOI: 10.7906/indecs.22.3.5
Regular article

Received: 24 May 2024.
Accepted: 15 June 2024.

ABSTRACT

The article presents the use of artificial intelligence to address the challenges Ukraine faces due to aggression, which causes significant damage to infrastructure, the economy, and society. The reconstruction process is complex and resource-intensive, with limited available resources. The potential for reparations from the aggressor is uncertain, prompting the need for financial assistance from Western partners and private investors. Ensuring the transparent and effective use of funds along with guarantees of investment protection is crucial. The Ukrainian government must also work on attracting people and businesses back to the affected areas, which is vital for community revival. It is important to develop a clear, well-justified vision for the restoration and development of regions, especially those near the zones of the aggression. This process involves collecting and analysing demographic data, spatial planning, and infrastructure development, complicated by active hostilities and resource constraints. Artificial intelligence technologies present significant opportunities in this restoration process. The potential of Artificial intelligence creates conditions for planning infrastructure projects by analysing large datasets to identify optimal construction sites. Additionally, Artificial intelligence can support the development of innovative technologies to enhance economic stability and attract investments by creating new business opportunities and improving the quality of life in areas such as education, healthcare, employment, and transportation. The role of Artificial intelligence extends to ensuring Ukraine's defence capability, improving existing systems, predicting the military situation, and enhancing communication within military units. However, the successful implementation of Artificial intelligence's growing potential requires substantial investments in research, development, and practical implementation. Developing open-source intelligent models to solve specific tasks and continuous user support are essential for leveraging Artificial intelligence's full potential in Ukraine's recovery and development.

KEY WORDS

artificial intelligence, reconstruction, economic stability, infrastructure development, defence capability

CLASSIFICATION

JEL: O13

*Corresponding author, η: kovalevskii61@gmail.com; +380504780394;
Parkova str. 83/213, Kramatorsk, Ukraine, 343932

INTRODUCTION

Ukraine is on the threshold of large-scale changes caused by both internal and external factors. In the conditions of European integration, rapid technological progress and socio-economic transformations, the role of artificial intelligence (AI) is becoming increasingly significant. Modern challenges, such as the need to rebuild infrastructure, optimize production processes, attract investments and improve the quality of life of the population, require innovative approaches [1]. AI, with its potential for automation, analysis of large volumes of data and creation of new technological solutions, can become an important driver of these transformations.

The reconstruction of Ukraine after the war, economic stability and development, the involvement of youth and qualified personnel in the reconstruction of the destroyed territories – all these are critical tasks that require an integrated approach. The implementation of AI technologies can significantly increase the efficiency of planning and implementation of infrastructure projects, the development of new business opportunities, as well as improving the quality of life in various areas, including education, health care, and transportation [2].

The purpose of this work is to study the role of artificial intelligence as a key factor in the transformation of the socio-economic system of Ukraine. The article analyzes the possibilities of using artificial intelligence technologies to rebuild and develop infrastructure, create innovative technologies, attract investments, and improve the quality of life of the population [3]. The main emphasis is on how artificial intelligence can contribute to the optimization of production processes, increase the competitiveness of industrial sectors and ensure the sustainable development of Ukraine.

In particular, the article is aimed at achieving the following tasks:

- analysis of the application of artificial intelligence in the planning and implementation of infrastructure projects, which will contribute to the rapid and effective reconstruction of the country after military actions.
- study of the impact of innovative technologies on the optimization of production processes and increasing the competitiveness of Ukrainian industry.
- consideration of the possibilities of using artificial intelligence to attract investment, create new business opportunities and improve the quality of life of the population in various areas, including education, health care and transport.
- determination of challenges and prospects associated with the introduction of artificial intelligence into the socio-economic system of Ukraine, as well as the development of strategic directions to ensure sustainable development and competitiveness of the country at the international level.

BASIC PART

In modern conditions, Ukraine faces a number of serious challenges that require innovative approaches and technological solutions. Military conflict, economic difficulties, the need to restore infrastructure, as well as the rapid pace of technological development and integration into the European space – all this determines the relevance of research into the role of AI as a driver of socio-economic transformation in the following areas:

1. Infrastructure reconstruction.

1.1. Management of urban infrastructure: the development of cities and their infrastructure requires effective management, especially in the face of rapid population growth and urbanization. Artificial intelligence can help optimize urban systems such as transportation, energy, water supply, and waste management. Intelligent systems are capable of analyzing data flows in real time, which allows for more efficient management of resources and improvement of the quality of life of city dwellers.

1.2. Improving agriculture: agriculture is an important branch of the Ukrainian economy, and the introduction of innovative technologies can significantly increase its efficiency. Artificial intelligence can be used to optimize the processes of growing crops, managing resources, predicting yields and controlling pests. This will help increase productivity, reduce costs, and ensure the country's food security.

2. Optimization of production processes.

2.1. Innovative development: the introduction of innovative technologies is a key element for economic development and stability. AI can contribute to the development of new methods of energy extraction, crop processing and goods production. This allows you to create new business opportunities and improve the economic situation in the country.

2.2. Support of small and medium-sized businesses: small and medium-sized businesses are an important element of the economic system of any country. Artificial intelligence can help these businesses increase efficiency, reduce costs and improve customer service. Intelligent systems can automate marketing, logistics, inventory management and other business processes, allowing small and medium-sized enterprises to focus on their core competencies and expanding markets.

2.3. Development of the digital economy: the modern world is rapidly moving towards a digital economy where information technology and artificial intelligence play a key role. For Ukraine, which seeks to integrate into the global market, the development of the digital economy is an important strategic direction. Artificial intelligence can contribute to the creation of new digital platforms, the automation of business processes, the development of e-commerce and digital services, which will increase the country's competitiveness in the international arena.

3. Innovative development.

3.1. Supporting innovation and scientific research: Artificial intelligence can promote scientific research and innovation by helping scientists analyze large amounts of data, model complex processes, and create new theoretical models. This opens up new opportunities for scientific discovery and technological innovation, which contributes to the overall progress of society.

3.2. Development of intellectual potential: the use of AI contributes to the development of the country's intellectual potential. This includes the training of qualified personnel in the field of information technologies, raising the level of education and science, as well as stimulating innovative entrepreneurship. Ukraine has a significant intellectual resource that can be effectively used to develop the latest technologies and ensure economic growth.

4. Socio-economic stability.

4.1. Ensuring social justice: Artificial intelligence can be used to create a more just and inclusive socio-economic system. Intelligent systems can help identify and eliminate discrimination, develop policies aimed at supporting vulnerable populations, and ensure equal access to resources and opportunities for all citizens.

4.2. Social inclusion: the use of AI technologies can contribute to increasing social inclusion, providing access to education, health care and other social services for broad segments of the population. Intelligent systems can help create inclusive educational programs, develop medical solutions for people with special needs, and improve access to social infrastructure.

5. Management and security.

5.1. Improving management efficiency: AI can significantly improve management processes at all levels, from government to corporate. Intelligent systems can automate routine tasks, allowing managers to focus on strategic issues. In addition, AI is able to analyze large volumes of data, which allows for more informed and effective management decisions.

5.2. Ensuring national security: The use of artificial intelligence in the field of defense and national security can significantly improve the effectiveness of military operations and the protection of critical infrastructure. Intelligent systems can help develop new defense technologies, improve the management of military resources, and analyze and predict military threats.

5.3. Improving security and transparency: Artificial intelligence can play a key role in improving information security and transparency in various fields. Intelligent systems can provide effective monitoring and protection of critical infrastructure from cyber-attacks, as well as help prevent fraud and corruption by analyzing anomalous behavioral patterns.

6. Investment attraction.

6.1. Global integration and partnership: the use of artificial intelligence can contribute to the greater integration of Ukraine into the global economy and the expansion of international partnerships. Intelligent technologies make it possible to quickly adapt to international standards, which opens up new opportunities for cooperation with other countries and organizations at the global level.

7. Improving the quality of life.

7.1. Adapting to global changes: the modern world is characterized by rapid changes caused by globalization, technological progress and environmental challenges. Ukraine, as a part of global society, must adapt to these changes in order to remain competitive. Artificial intelligence can help predict global trends, develop adaptation strategies and implement innovative solutions to ensure sustainable development.

7.2. Environmental sustainability: one of the key challenges of modern times is to ensure environmental sustainability. AI can help in the development and implementation of environmentally friendly technologies, monitoring the state of the environment and predicting environmental risks. This contributes to the preservation of natural resources and the minimization of the negative impact of production activities on the environment.

Automation requires the adaptation of processes and procedures to new conditions. The speed and scale of automation implementation depend on numerous factors, including the engineering aspects of specific tasks and the features of non-technical management of organizational transformations [4]. The dynamics of regulation and decision-making in the field of technology implementation are also significant. It is important to note that automation can play a positive role without leading to job losses [5, 6]. This is achieved thanks to the latest advancements in technology, such as robotics, artificial intelligence, and machine learning. Such automation has the potential to transform routine work, making it more productive and freeing people to perform more complex and creative tasks.

Table 1 presents the main categories of technological systems along with their characteristics. Each system differs by type of technology, degree of automation, and area of application. This information is crucial for further analysis and understanding of the impact of technological systems on production. It reveals the progressive nature of the evolution of technological systems from traditional concentrated to intelligent networked manufacturing systems.

It should be noted that the methodological approach based on coding information about technological systems is extremely important in the context of analysis and classification of these systems. Its effectiveness is determined by several key factors. Firstly, coding allows structured presentation of system characteristics in the form of numerical values or symbols, simplifying further analysis and comparison. Additionally, this approach opens up the possibility of using mathematical methods, such as clustering algorithms, for processing and

Table 1. Types of Technological Systems: Types, Automation, and Application.

Technological System	Type of Technology	Degree of Automation	Area of Application
Traditional Concentrated Manufacturing Systems	Mechanical, Electromechanical	Low level of automation	Series production of standardized products
Automated Concentrated Manufacturing Systems	Electromechanical, Electronic, Information and Communication, etc.	Medium level of automation	Automated systems allow producing series products with high precision and speed
Integrated Manufacturing Systems	Electromechanical, Electronic, Information and Communication, etc.	High level of automation and integration	Manufacturing systems, integrated sections and workshops with high levels of automation and integration
Networked Manufacturing Systems	Electromechanical, Electronic, Information and Communication, etc.	High level of automation and integration focused on networking and logistics	Manufacturing systems, networked manufacturing complexes based on integrated technological networks
Intelligent Networked Manufacturing Systems	Electromechanical, Electronic, Information and Communication, etc.	High level of automation and integration with a high level of intellectualization	Networked manufacturing complexes with a higher degree of intellectualization aimed at maximizing efficiency and resource conservation

grouping similar systems. Moreover, coding provides objectivity in evaluation, as it is based on clear criteria and reduces subjective influences on conclusions.

Table 2 presents the classification characteristics of technological systems shown in Table 1 and provides ratings in the form of scores for each characteristic. Characteristics include organizational and structural characteristics (simple, complex, and integrated systems), degree of automation (from manual to robotic systems), production nature (discrete and continuous production), product release nature (exclusive, series, and mass production), degree of order and entropy (structure and degree of chaos), efficiency (from low to high), type of management (mechanical, electronic, using artificial intelligence), and degree of integration with information technologies (from low level of informatization to using Industry 4.0 technologies). Each characteristic is assigned scores according to its importance and impact on the system's characteristics. This scoring approach has its justified rationale in normalizing the evaluation of different factors. Using a uniform scoring range from 1 to 12 avoids the advantages or disadvantages of certain categories of evaluations over others. This creates more objective conditions for comparison and analysis of various aspects of technological systems. For example, it is important when determining priorities in developing technological solutions or assessing their effectiveness.

Additionally, this approach simplifies the use of scores in mathematical models and analytical calculations, as they have the same scale. Such normalization contributes to clear and consistent interpretation of analysis and evaluation results of technological systems, which is an important step in making informed technical decisions based on the overall evaluation of the technology system codes, Table 3.

Table 2. Score evaluation of technological system classification by key characteristics.

Classification Characteristic	Type	Score
By organizational and structural characteristics: A	Simple technological systems (e.g., single machines) - A1	4
	Complex technological systems (e.g., production lines) - A2	8
	Integrated technological systems (e.g., automated factories) - A3	12
By degree of automation: B	Manual systems – B1	3
	Semi-automated systems - B2	6
	Automated systems - B3	9
	Robotic systems – B4	12
By production nature: C	Discrete manufacturing systems (production of individual items) - C1	6
	Continuous manufacturing systems (continuous production process) - C2	12
By product release nature: D	Exclusive production - D3	4
	Series production - D2	8
	Mass production – D1	12
By degree of order and entropy: E	Low order and high entropy (unstructured systems) - E1	6
	High order and low entropy (structured systems) - E2	12
By degree of efficiency: F	Low efficiency - F1	4
	Average efficiency - F2	8
	High efficiency (achieving maximum results with minimal costs) - F3	12
By type of management: G	Mechanical management – G1	4
	Electronic management – G2	8
	Management using artificial intelligence - G3	12
By degree of integration with information technologies: H	Systems with a low level of informatization – H1	4
	Information-driven systems – H2	8
	Systems using Industry 4.0 technologies - H3	12

Table 3. Overall scores of technological system codes.

Technological System	Code	Total Code Score
Traditional Concentrated Manufacturing Systems	A1B1C2D2E1F1G1H1	45
Automated Concentrated Manufacturing Systems	A2B3C2D2E2F2G2H2	73
Integrated Manufacturing Systems	A3B3C2D2E2F2G2H2	77
Networked Manufacturing Systems	A3B3C2D2E2F2G2H3	81
Intelligent Networked Manufacturing Systems	A3B4C2D2E2F3G3H3	82

Each letter in the code represents a specific characteristic, and each number is assigned to establish scores that reflect the importance of that characteristic. This scoring system allows summarizing the comprehensive evaluation of technological systems and comparing their effectiveness based on key indicators. Specifically, it considers the degree of automation, production nature, type of management, integration with information technologies, and other

aspects. Given that the scoring scale is unified and has the same range, it enables objective comparison of different technological systems regardless of their complexity.

Based on the evaluation results, it is evident that the *Intelligent Networked Manufacturing System* received the highest overall code score of 82 points, indicating a high level of integration, automation, and efficiency of this system. This highlights its great potential for innovative development in the field of mechanical engineering, as it incorporates the most advanced technologies and management systems. Consequently, the main directions for innovative development in the field of mechanical engineering have been formed, including the assessment of technical and technological needs. Firstly, this involves analyzing various technical and technological aspects of mechanical engineering, which includes evaluating modern methods, materials, and technologies that can be used to improve production processes and create high-quality products. Financial planning and resources become important, considering potential funding sources such as investors, grants, loans, and other resources that ensure the successful development of the industry. The idea of creating intelligent manufacturing systems, based on the analysis and implementation of advanced computer models, is gaining traction. These systems help improve the automation of production processes, increase productivity, and enhance the quality of produced products. The use of cyber-physical systems in manufacturing is of particular importance, as they result from the merging of the real and virtual worlds, opening up new opportunities for optimizing production processes [7]. The implementation of cyber-physical systems encompasses autonomous robots, augmented reality, advanced manufacturing, and the integration of manufacturing enterprises.

DISCUSSION

In the current conditions of Ukraine's integration into the European space and rapid technological progress, AI is becoming an important tool for ensuring sustainable development and the country's competitiveness. The discussion of the research results demonstrates the potential of AI in various fields, including infrastructure reconstruction, optimization of production processes, innovative development, and improving the quality of life of the population.

Infrastructure Reconstruction

One of the key areas for the application of AI is the reconstruction of infrastructure destroyed by military actions. Intelligent systems can analyze large volumes of data in real time, allowing for effective resource management, optimization of transportation systems, energy supply, water supply, and waste management [8]. This contributes to improving the quality of life of the population and the rapid restoration of urban infrastructure.

Optimization of Production Processes

Innovative technologies based on AI have the potential to significantly increase the efficiency of production processes in Ukraine. The application of AI in manufacturing allows for the development of new methods of energy extraction, agricultural crop processing, and goods production. This creates new business opportunities and improves the economic situation in the country. Additionally, AI supports small and medium-sized enterprises by automating marketing, logistics, and inventory management, allowing businesses to focus on their core competencies and market expansion [9].

Innovative Development

AI promotes the development of scientific research and innovation by helping scientists analyze large volumes of data, model complex processes, and create new theoretical models. This opens up new opportunities for scientific discoveries and technological innovations,

contributing to the overall progress of society. The development of the country's intellectual potential also includes the training of qualified personnel in information technology, raising the level of education and science, and stimulating innovative entrepreneurship.

Socio-Economic Stability

AI can be used to create a more just and inclusive socio-economic system. Intelligent systems help identify and eliminate discrimination, develop policies to support vulnerable populations, and ensure equal access to resources and opportunities for all citizens. The use of AI in the social sphere contributes to increasing social inclusion, access to education, healthcare, and other social services for broad segments of the population.

CONCLUSIONS

Based on the conducted research, the following conclusions can be drawn.

AI AS A KEY FACTOR IN TRANSFORMATION

AI has the potential to significantly impact the development of Ukraine's socio-economic system, contributing to infrastructure reconstruction, optimization of production processes, attracting investments, and improving the quality of life of the population.

EFFICIENCY IN INFRASTRUCTURE MANAGEMENT

The application of intelligent systems in planning and managing infrastructure projects contributes to the rapid and effective reconstruction of the country after military actions, improving urban management, and ensuring sustainable development.

SUPPORT FOR SMALL AND MEDIUM ENTERPRISES

AI helps small and medium-sized enterprises increase efficiency, reduce costs, and improve customer service by automating business processes.

DEVELOPMENT OF SCIENCE AND INNOVATION

AI promotes the development of science and innovation, opening new opportunities for scientific discoveries, technological progress, and increasing the country's intellectual potential.

SOCIAL JUSTICE AND INCLUSION

The use of AI helps create a more just and inclusive socio-economic system, ensuring equal access to resources and opportunities for all citizens.

Given the research results, it is important to continue developing and implementing policies aimed at integrating artificial intelligence into all spheres of public life. This will not only ensure the rapid reconstruction of infrastructure and optimization of production processes but also contribute to the long-term sustainability and competitiveness of Ukraine on the international stage. Special attention should be paid to the development of education and the training of qualified personnel who can effectively utilize the opportunities provided by artificial intelligence to address current issues and challenges.

REFERENCES

[1] Simon, J. and Mester, G.: *Critical Overview of the Cloud-Based Internet of Things Pilot Platforms for Smart Cities.*
Interdisciplinary Description of Complex Systems **16**(3-A), 397-407, 2018,
http://dx.doi.org/10.7906/indecs.16.3.12,

[2] Armenia, S.; Franco, E.; Iandolo, F.; Maielli, G. and Vito, P.: *Zooming in and out the landscape: Artificial intelligence and system dynamics in business and management*. Technological Forecasting and Social Change **200**, No. 123131, 2024, http://dx.doi.org/10.1016/j.techfore.2023.123131,

[3] Nahar, S.: *Modeling the effects of artificial intelligence (AI)-based innovation on sustainable development goals (SDGs): Applying a system dynamics perspective in a cross-country setting*. Technological Forecasting and Social Change **201**, No, 123203, 2024, http://dx.doi.org/10.1016/j.techfore.2023.123203,

[4] Ghobakhloo, M., et al.: *Intelligent automation implementation and corporate sustainability performance: The enabling role of corporate social responsibility strategy*. Technology in Society **74**, No. 102301, 2023, http://dx.doi.org/10.1016/j.techsoc.2023.102301,

[5] Innocenti, S. and Golin, M.: *Human capital investment and perceived automation risks: Evidence from 16 countries*. Journal of Economic Behavior & Organization **195**, 27-41, 2022, http://dx.doi.org/10.1016/j.jebo.2021.12.027,

[6] Haidegger, T., et al.: *Robotics: Enabler and inhibitor of the Sustainable Development Goals*. Sustainable Production and Consumption **43**, 422-434, 2023, http://dx.doi.org/10.1016/j.spc.2023.11.011,

[7] Edje, A.E.; Abd Latiff, M.S. and Chan, W.H.: *IoT data analytic algorithms on edge-cloud infrastructure: A review*. Digital Communications and Networks **9**(6), 1486-1515, 2023, http://dx.doi.org/10.1016/j.dcan.2023.10.002,

[8] Ulatowska, R.; Wainio, E. and Pierzchała, M.: *Digital transformation in HRM of the modern business service sector in Finland and Poland*. Journal of Organizational Change Management **36**(7), 1180-1192, 2022, http://dx.doi.org/10.1108/JOCM-11-2022-0339,

[9] Amalu, E.H., et al.: *Critical skills needs and challenges for STEM/STEAM graduates increased employability and entrepreneurship in the solar energy sector*. Renewable and Sustainable Energy Reviews **187**, No. 113776, 2023, http://dx.doi.org/10.1016/j.rser.2023.113776.