УДК 338.1: 339.9:004(06)

S. Arefiev, Doctor of Economic Sciences, Associate Professor,
(HSRM WIESBADEN BUSINESS SCHOOL, RESEARCH FELLOW, Wiesbaden, Germany)

Digitalization of the Economy on the Basis of Artificial Intelligence: Circular Economy and Development Prospects in Europe

The thesis substantiates the need for digitalisation of the economy on the basis of artificial intelligence, the expediency of further implementation of the benefits of the circular economy in terms of the prospects for European development; the opportunities offered by new technologies for business and economic security are identified.

The circular economy, or closed-loop economy, is becoming a foundation for sustainable development strategies aimed at reducing environmental impact and optimizing resource use. Europe is actively promoting this concept as a response to contemporary challenges arising from the growing amount of waste, limited natural resources, and the need to reduce greenhouse gas emissions. In this context, digitalization based on artificial intelligence (AI) is a key tool that accelerates the achievement of circular economy goals, providing new opportunities for businesses, governments, and society. “Modern globalization challenges that affect the development of economic systems, including at the regional level, include a growing environmental crisis, a shortage of traditional production resources, such as energy, increasing demographic imbalances, growing social inequality, deformation of market structures, and a crisis of capital investment efficiency, among others. The principles of sustainable development dictate the ideology of reasonable sufficiency, mutual assistance, and directing efforts toward the development of the social and ecological spheres of social” [3, p. 3713].

Artificial intelligence has the potential to significantly transform approaches to resource management, waste recycling, demand forecasting, and the creation of innovative business models. AI applications allow for more accurate assessment and control of material use, reduction of waste, and resource reuse. In addition, «the development of digital technologies and transformation of international competitiveness create new opportunities for the expansion of commercial communication in the electronic business environment. Thus, the use of information technologies becomes a necessary condition for the functioning of companies and ensuring their competitiveness in the international market. [5]

In Europe, there are already numerous examples of successful AI implementation to address circular economy challenges, such as urban waste management, supply chain optimization, and increasing energy efficiency. These technologies help European municipalities and companies achieve significant cost reductions and lower environmental impact.

In production processes, artificial intelligence helps optimize resource use, minimize waste, and create longer-lasting products. AI-driven demand forecasting

allows companies to avoid overproduction and reduce the number of unsold goods, thereby decreasing waste volumes and increasing production efficiency. AI also facilitates the implementation of "product-as-a-service" models, where companies provide products for use rather than selling them outright, ensuring reuse and recycling, which aligns with circular economy principles. “The concept of a circular economy involves the efficient use of resources and a reduction of the negative impact on the environment from the production and consumption of goods and services on all cycles, that is, from the extraction of raw materials to the final use” [1, p.1528].

In the energy sector, AI-based digital technologies enable analysis of energy consumption, demand forecasting, and optimization of renewable energy use. This contributes to reducing greenhouse gas emissions and increasing energy use efficiency. In Europe, numerous projects are already being implemented to create "smart" cities, where all processes — from energy consumption to transport management — are controlled and optimized using AI.

Digitalization based on AI also opens up new opportunities for developing innovative business models aligned with circular economy principles. For instance, shared resource platforms help reduce costs and minimize waste. Such platforms facilitate the reuse of products and materials, helping to save resources and create new economic opportunities. AI also supports sustainability-oriented businesses by providing analytical tools to identify new market opportunities.

Emerging technologies such as artificial intelligence, blockchain and the Internet of Things (IoT) are rapidly changing the economic landscape. Artificial intelligence (AI) is capable of automating complex processes, analysing large amounts of data and making decisions that previously required human intervention. These capabilities open up new horizons for business, but also require new approaches to ensuring economic security.

The use of blockchain technologies ensures transparency and security of transactions, but requires adaptation to new regulatory standards. The Internet of Things (IoT) allows for the creation of networks of interconnected devices that collect and analyse data in real time, which also requires enhanced security measures to protect against possible threats and attacks.

However, the implementation of AI in the circular economy is accompanied by several challenges. One of the main ones is ensuring data security, as digitalization requires the collection and processing of large volumes of information, which may include confidential data.

Ethical aspects also play an important role: it is necessary to ensure that AI use does not lead to discrimination or other unfair consequences. Another challenge is the need for investments in new infrastructure and training for staff who will work with modern technologies. To better understand the impact of AI-based digitalization on the development of the circular economy in Europe, a research table is proposed that reflects the main directions, prospects, and challenges of using AI in this context.

Table 1

The impact of AI-based digitalization on the circular economy in Europe

Research Table on the Impact of AI-Based Digitalization on the Circular Economy in Europe	Economic Prospects	Environmental Prospects	Social Prospects	Implementation Challenges
Resource Management	Optimization of logistics, cost reduction in recycling and reuse	Reduction of waste, increase in recycling and reuse levels	Development of new jobs in recycling and resource reuse sectors	Ensuring data accuracy, data confidentiality, and security
Production Processes	Reduction in production costs through resource use optimization	Reduction of industrial waste, decrease in raw material consumption	Creation of new opportunities for small and medium-sized businesses	Investment in new technologies, modification of existing business models
Energy	Reduction in energy costs, increased efficiency of renewable energy use	Reduction of greenhouse gas emissions, development of "green" technologies	Increased accessibility and stability of energy supply	Infrastructure development, training of qualified personnel
New Business Models	Creation of new market opportunities, expanded access to products and services	Improved efficiency in material and energy use	Social benefits from shared resource use, cost reduction for consumers	Addressing ethical issues related to AI use, avoiding discrimination

This table shows that AI-based digitalization opens significant prospects for the development of the circular economy in Europe by enhancing economic efficiency, reducing environmental impact, and creating new social opportunities. However, realizing this potential requires addressing several important challenges, such as data security, ethical use of technologies, the need for investment in infrastructure, and training.

The research findings suggest that AI-based digitalization is not just a new technological trend but a strategic direction for ensuring sustainable development. It offers opportunities to enhance the competitiveness of European companies, reduce dependence on imported resources, improve quality of life, and create new jobs. In particular, the development of a circular economy supported by AI contributes to more efficient resource use, pollution reduction, energy savings, and waste reduction. This creates closed production and consumption cycles where resources are used as efficiently and repeatedly as possible.

Europe has all the potential to become a global leader in developing a circular economy based on artificial intelligence. This will require active government support, the implementation of stimulating policies, and the creation of favorable conditions for businesses and society to embrace these innovative changes. As the world moves towards a more sustainable future, AI will play a vital role in shaping an economy that is not only innovative but also socially responsible and environmentally sustainable.

Conclusion.

Thus, AI-based digitalisation is a new technological trend, and the strategic direction of sustainable development opens up opportunities to increase the competitiveness of European companies, reduce dependence on imported resources, improve the quality of life and create new jobs. Ethical aspects play an important role in the introduction of new technologies, so it is necessary to ensure that the use of AI does not lead to discrimination or other unfair consequences and facilitates staff training,

References

1. Arefiev S, Shevchenko I, Savkiv U, Hovsieiev D, Tsizhma Y. Management of the global competitiveness of companies in the field of electronic commerce in the conditions of digitalization. *Journal of Theoretical and Applied Information Technology*. 2023. Vol.101. No 4. P. 1527-1537. https://www.jatit.org/volumes/Vol101No4/31Vol101No4.pdf
2. Iarmosh, O., Prokhorova, V., Shcherbyna, I., Kashaba, O., & Slastianykova, K. Innovativeness of the creative economy as a component of the Ukrainian and the world sustainable development strategy (2021). *IOP Conference Series: Earth and Environmental Science, 628(1).* Режим доступу: https://www.scopus.com/record/display.uri?eid=2-s2.0-85100727399&origin=resultslist&sort=plf-f
3. Chernoivanova H., Lepeyko T.,Pererva I., Poberezhna Z., Zabashtanska T.The Role of the Mechanism of AttractingInvestment Resourcesinthe InnovativeDevelopment of Enterprises inthe Context of the Digital Economy Development. International Journal of Sustainable Development and Planning, 2023, Vol. 18, No. 12, pp. 3713-3723. https://doi.org/10.18280/ijsdp.181203
4. Korytko T., Piletska S., Arefieva O., Pidhora Ye., Fomichenko I. (2021). The system of evaluating the effectiveness of employees motivation as a factor of the enterprise sustainable development. *Management Theory and Studies for Rural Business and Infrastructure Development.* Vol. 43, No. 4, pp. 545-554. URL : DOI: https://doi.org/10.15544/mts.2021.49
5. Kuzior Aleksandra, Arefieva Olena, Poberezhna Zarina, Ihumentsev Oleksiy. The Mechanism of Forming the Strategic Potential of an Enterprise in a Circular Economy. Sustainability. 2022, 14, 3258.