

Evaluating the impact of innovative technologies on global competitiveness through modelling



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Abstract The present academic paper considers modeling of the impact of innovative technologies on global competitiveness. The research methodology includes analysis of economic data, statistical modeling, case studies, and expert assessments. The research results make it possible to fully understand how innovations influence productivity, operating costs, market opportunities and other aspects of competitiveness. The developed model can serve as a basis for developing strategies for introducing innovations at the state and corporate levels. Understanding the impact of innovations on competitiveness is essential in a rapidly changing global economy where competition is becoming increasingly fierce. The importance of innovations in generating competitiveness is emphasized. The developed model of the impact of innovative technologies on international competitiveness contributes to the creation of sustainable competitive advantages for companies and countries. Increasing efficiency and productivity, reducing operating costs and expanding market opportunities allow companies to compete more effectively on a global scale. Improving the quality of products and services, supported by ongoing investments in research and development, strengthens market positions and drives long-term growth. It should be noted that the focus on education, skills and international cooperation provides access to the best perspectives and technologies and strengthens global innovation leadership.

Keywords: innovative technologies, global competitiveness, modeling of impact, effectiveness, competitive advantages

1. Introduction

In the modern world, technological progress and innovations have become an integral part of the global economy and have a huge impact on the global competitiveness of countries and regions. Studying and analyzing the impact of innovative technologies on competitiveness is becoming a priority goal of the research. This topic is an important field of exploration that provides a better understanding of how innovations form the economic environment and what factors influence the success of countries and organizations at the global level. A model of the impact of innovative technologies on global competitiveness is introduced and characterized in the context of the present academic paper. In the world of technological progress, competition in global markets is gaining intensity, and attention to innovation and its purpose in ensuring competitiveness is becoming a significant element of strategic development. The proposed model, its description and features are aimed at expanding the knowledge of how modern innovative technologies can shape the global picture of competitiveness (Erfan & Labetska, 2023).

In the modern world, where technological progress and innovation have become the driving force of economic development, the issue of the level and ability of states and organizations to compete on the global stage is at the forefront. Despite the general recognition of the importance of innovations, many countries and companies face challenges in successfully implementing innovations and influencing competitiveness (Kovalko et al., 2022). The challenge posed in the present academic paper is the necessity to understand and model the impact of innovative technologies on international competitiveness. Driven by the development of the digital economy and the technological revolution, countries and businesses are facing the issue on how they should use innovations to achieve a sustainable competitive advantage. Developing models



of the impact of innovations allows us to more accurately identify strategies and solutions to improve competitiveness on the global stage (Shvydanenko et al., 2007).

The purpose of the academic paper is to develop a model of the impact of innovative technologies on global competitiveness, which will provide a deeper understanding and assessment of the impact of innovations in the research area.

2. Literature review

Istomina, A., Vinogradova, M., Lukyanova, A., Dobrovolskaya, O., & Prodanova, N. (2020) explore a new leadership strategy in the digital age that affects the competitiveness of countries and macro-regions. The scientific article emphasizes the importance of innovations and digitalization in the context of global competition. Batsurovska I. et al. (2021) discuss methods of acquiring competencies by bachelors in higher educational institutions in the conditions of the digital communication environment. The research emphasizes the significance of adapting educational processes to modern digital technologies. Kniaz S., Bogiv Ya. and Georgiadi N. (2020) analyze business planning of innovative projects, assessing their nature, advantages and disadvantages. The academic paper makes a contribution to the comprehension of key aspects of innovation planning in business. Yudina E. (2016) considers the modeling of the impact of technological innovations on improving production efficiency. The research emphasizes the significance of innovations for the manufacturing sector. Bobryshev Ye. (2023) analyzes the influence of financial technologies on the stability of the national economy. The scientific article is relevant for understanding the role of fintech in economic security. Humeniuk I. (2023) studies the impact of information technologies on the state's economy. The publication emphasizes the importance of digitalization for economic development. Erfan Ye. and Labetska M. (2023) study the influence of global technologies on the development of the global transportation market. The study is essential for understanding technological trends in the transportation industry. Makarenka S., Likanova A., and Pleshivtseva A. (2021) study the introduction of innovative technologies in personnel management. The scientific work is important for understanding the role of innovation in HR. Mogylina L., Oriekhova A., and Khromushyna L. (2022) consider the use of innovative IT technologies for HR management. The publication emphasizes the significance of technology in modern HR management. Nesterenko, V., Moroz, A. and Bolotova, T. (2022) explore innovations in agricultural entrepreneurship and their impact on competitiveness. The study is relevant for understanding innovative trends in the agricultural sector. Pavlenko I. (2007) analyzes innovative entrepreneurship in the transformational economy of Ukraine. The publication is valuable for understanding changes in the country's economic environment. Samoilenko O. et al. (2018) discuss the model of training specialists in the conditions of open mass distance courses. The study is essential for understanding new approaches in higher education. Tymoshenko M. et al. (2023) investigate the impact of Industry 4.0 on modeling energy development scenarios for developing economies. The scientific article is relevant for understanding technological changes in the energy sector. Fedorova Yu. (2021) considers innovative information technologies in the training and management of personnel. The study emphasizes the importance of IT solutions in the HR sector.

Voinova E. (2018) explores the country's global competitiveness, considering its categories, types, factors and consequences. The scientific article is important for understanding the multidimensional nature of competitiveness in the context of globalization. Havrysh O. and Karpenko I. (2023) discuss innovations as an imperative for the competitiveness of multinationals on the global markets. The publication highlights the relevance of the innovation strategy of international business. Zhalilo Ya. et al. (2005) consider the competitiveness of Ukraine's economy in the context of globalization. The research is significant for understanding the strategies of the Ukrainian economy in the international arena. Kuliavets V. (2021) analyzes Ukraine's international competitiveness in the context of globalization, highlighting the problems and prospects. The scientific article is relevant for understanding the impact of global processes on national economies. Slavkov M., Kalantaievska O., and Hubar O. (2023) study the impact of innovation management on enterprises' competitiveness in the modern world. The research emphasizes the role of innovations in business management. Taranenko I. and Taranenko Yu. (2011) analyze econometric models of the impact of globalization and innovation factors on the competitiveness of countries. The study is crucial for understanding the interrelation between global processes and economic performance indicators. Shvydanenko, O. (2007) studies theoretical and applied aspects of global competitiveness. The publication is valuable for understanding a comprehensive approach to the study of competitiveness. Mechanic O. (2006) analyzes competitiveness as a socio-economic category, its essence, structure, classification and fundamentals of formation. The scientific work is relevant to understanding the multidimensionality of competitiveness. Bazyliuk, Ya. (2002) considers the essence and conditions of ensuring the competitiveness of the national economy. The study is important for understanding the factors that influence economic competition. Polunyiev, Yu. (2010) studies the country's competitiveness as an economic category and development strategy. The article emphasizes the significance of a strategic approach to economic management. BusinessWorld Online (2022) presents the World Competitiveness Ranking for 2022. The information is essential for assessing global economic trends.

The analyzed literature sources include various aspects of the impact of innovative technologies on competitiveness. At the same time, modeling of the impact of innovative technologies on global competitiveness has not been sufficiently considered in the scientific literature yet.

a number of areas, including the primary areas of influence, the influence of external variables, and the strategic directions for sustainable development. Let us consider the outlined directions and provide key characteristics for them.

The main areas of influence include increasing productivity and efficiency, reducing operating costs, expanding market opportunities and improving the quality of products or services.

Increasing productivity and efficiency. Innovations improve business processes, reducing the time and resources required to complete tasks. Increasing productivity and efficiency through innovative technologies leads to the optimization of workflows and the reduction of time to complete tasks. Automation and digitalization significantly reduce the likelihood of errors and improve the quality of work, ensuring higher reliability and consistency of results. These improvements contribute to increased production and improved customer service while reducing overall operating costs.

Reducing operating costs. Automation and optimization of processes lead to significant cost savings. Increasing productivity and efficiency by means of innovative technologies leads to the optimization of workflows and the reduction of time to complete tasks. Automation and digitalization significantly reduce the likelihood of errors and improve the quality of work, ensuring higher reliability and consistency of results. These improvements contribute to increased production and improved customer service while reducing overall operating costs (Istomina et al., 2020).

Expanding market opportunities. Technologies enable companies to enter new markets and develop innovative products and services. Expanding market opportunities through innovative technologies, companies can offer unique products and services, open new markets and segments. This facilitates the development of personalized solutions and strategies that address the specific needs of different customer groups, leading to an expanded customer base and increased revenue.

Improving the quality of products or services. Current technologies contribute to improving the standards and quality of products manufactured by companies. Improving the quality of products and services through innovations leads to increased customers' satisfaction and strengthening of brand reputation. Advanced quality control systems and production automation ensure higher standardization and reduction of defects, which directly affects the durability and reliability of products (Kulyavets, 2021).

External factors and influences refer to the impact of global trends and innovations and policy and regulation.

Global trends and innovations. The innovations include environmental friendliness, sustainable development and digitalization of society, digitalization, transition to renewable energy sources, etc. All these aspects have a significant impact on business practices and consumer preferences. It means creating new market opportunities for modern companies that adapt to innovative trends and offer environmentally friendly products and technologies. In addition, the growing demand for personalized and high-tech products encourages companies to systematically innovate and improve the quality of goods and services.

Policy and regulation. Legislative and regulatory changes may facilitate or restrict innovations. Policies and regulations have a profound impact on the development and diffusion of innovative technologies, setting the framework for their application and adoption. Legislation in the areas of data protection, environmental standards, and intellectual property directly affects companies' strategies for developing and commercializing new technologies. Adapting to rapidly changing regulatory standards requires companies to be flexible and innovative in order to maintain competitiveness and meet international standards (Fedorova, 2021).

Strategic areas for sustainable development include investments in research and development, education and skills, and international cooperation.

Investments in research and development. Ongoing investments in research are a key factor in maintaining innovation activity. Investments in explorations and developments are a crucial aspect of innovative growth. This can enable companies to develop new technologies and products. Such investments contribute to the creation of special competitive advantages and stimulate long-term innovative development. Stable financing is necessary to maintain technological leadership and adapt to market conditions and customer needs, taking into account modern innovative development.

Education and skills. Development of skills and education in the field of new technologies to train qualified specialists is of particular importance. Education and skills development are crucial for maintaining innovation capacity and adapting to new technological trends. Investing in education and professional development and improving knowledge helps create a skilled workforce. Such specialists are able to work effectively with advanced technologies. Lifelong learning and retraining is also essential to help ensure competitiveness in the face of technological change (Kovalko et al., 2022).

International cooperation. International cooperation and partnerships are significant for sharing knowledge and technology. International cooperation plays a key role in promoting innovative technologies through the exchange of knowledge and resources between countries and organizations. Such cooperation leads to the stimulation of global research and development, providing access to new markets and modern technological solutions.

Summarizing, it should be noted that the developed model of the impact of innovative technologies on global competitiveness contributes to the formation of a sustainable competitive advantage for companies and countries. Increasing efficiency and productivity, reducing operating costs and expanding market opportunities allow organizations to compete more effectively on a global scale. Improving the quality of products and services, supported by ongoing investments in research and development, strengthens our market position and drives long-term growth. In addition, the emphasis on education and skills,

as well as international cooperation, provides access to the best talents and technologies, strengthening global innovation leadership.

Istomina, A. I., Vinogradova, M. V. et al. (2020) in their research note that innovative technologies and digitalization play a crucial role in the development of global competitiveness of countries. The researchers point out that countries with advanced digitalization have higher competitiveness and, as a result, higher living standards. Investments in digital infrastructure and the development of an efficient digital economy empower countries by improving their competitiveness and reducing the development gap between regions (Table 1).

Table 1 Investments in digital infrastructure.

Country	Level of digitalization (ICT index)	Competitiveness rating
The USA	Average (compared to other developed countries)	1 (85.6 points)
Singapore	High	2 (83.5 points)
Germany	High	In top 10
The United Kingdom	High	In top 10
Argentina	Low	The last place (57.5 points)

Source: based on (Istomina et al., 2020).

For instance, countries with a high level of digitalization, such as Singapore and Germany, have a high competitiveness rating, while countries with a lower level of digitalization, such as Argentina, are at the bottom of the list.

Consequently, innovative technologies have a significant impact on global competitiveness and allow companies to increase efficiency, reduce costs and expand markets. Adopting the latest technologies requires a strategic approach, involving investments in research, development, skills acquisition and competency development systems (Popov et al., 2021).

The discussions include considerations of what strategies and investments might be most effective for countries seeking to improve their competitiveness. How to strike a balance between the advantages of contemporary technology and social and economic issues such as inequality and data security is another controversial topic. Other discussions include some aspects of the impact of digitalization on employment and the labor market, and regulation and policy in this area.

The issue of modeling the impact of innovative technologies on global competitiveness is reflected in numerous works of modern scientists. With the goal of achieving the expected effectiveness of the research of the potential of innovative solutions in the period of transformation of socio-economic processes, it is advisable to take into account the results of current developments regarding key concepts. It should be noted, at the same time, that the multifactorial nature of the process of modeling the impact of the implementation of technological innovation projects led to the existence of differences in approaches to structuring the basic functionality of the process and identifying the level of prospective feasibility.

In particular, a number of scientists focus on the problems of the phenomenon of competitiveness in a global aspect. In this context, it is worth highlighting scientists (Awan et al., 2021), who pay special attention to the need for the development of sustainable technologies, which they see as an effective tool for ensuring a sufficient level of competitiveness of the market object. Individual scientists (Suchek et al., 2021) focus on the analysis of the main principles of the impact of the innovative technological concept, considering it as a priority factor in the development of an integrated global environment in within the limits of purposeful development in the direction of sustainability.

A number of scientists (Shahzad, 2020; Aftab et al., 2023) convincingly testify that innovations based on modern technological capabilities, and even involving the potential of artificial intelligence, is a key tool for supporting the sustainable development of the economy. According to scientists, innovative technologies make it possible not only to protect natural resources from degradation, but also to regenerate resource potential.

The problems of the methodology of modeling the effectiveness of innovative projects are outlined in the works of a number of scientists (Feng et al., 2022), whose scientific research is focused on the development and practical testing of modern approaches to the analysis of the effectiveness of innovative activities. At the same time, many modern scientists (Li et al., 2021) are convinced that the priority of modern innovative activity is the implementation of environmentally safe, low-waste technological solutions and orientation to circular economic processes. At the same time, scientists interpret the concept of innovative technological activity as an intensifier of the dynamics of socio-economic development.

The majority of scientists have a common vision regarding the need to intensify innovative activity in the aspect of technological solutions, synergy in the direction of increasing competitiveness against the background of globalization and integration processes. Despite a significant range of scientific developments on the studied issues, most aspects regarding the practical mechanism of modeling the impact of innovative technologies on global competitiveness in the concept of the main principles of sustainable development require additional, broader research.

5. Conclusions

Thus, innovative technologies and digital transformation have a profound impact on economic competitiveness at the global level. The model of the impact of innovative technologies on global competitiveness confirms that digitalization and technological development are key factors in enhancing the competitive ability of countries. Countries that invest heavily in

digital infrastructure and ICTs demonstrate higher economic productivity and living standards. Effective integration of digital technologies into the economy promotes innovation, economic growth and social transformation. Therefore, digital transformation and innovation are becoming priorities in national economic development strategies to achieve global competitiveness.

Further studies in this area may include an analysis of specific digital transformation strategies and their impact on competitiveness, a study of the role of education and human resources in the context of the digital economy, and an analysis of macroeconomic factors that influence the successful implementation of innovative technologies.

Ethical considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

Funding

This research did not receive any financial support.

References

- Basiluk, Ya. B. (2002). *Competitiveness of the national economy: essence and conditions of provision*. Kyiv.
- Batsurovska, I., Dotsenko, N., Gorbenko, O., & Kim, N. (2021). The Technology of Competencies Acquisition by Bachelors in Higher Education Institutions in the Conditions of the Digital Media Communication Environment. *ICNTLLSC 2021 International Conference on New Trends in Languages, Literature and Social Communications (ICNTLLSC 2021)*. <https://notso.easyscience.education/icntllsc/2021/paper/22?cap=022awwOIUYong3k>
- Bobryshev, E. (2023). The influence of financial technologies on the stability of the national economy. *Economy and society*. <https://doi.org/10.32782/2524-0072/2023-52-96>
- BusinessWorld Online. (2022, June 15). World Competitiveness Ranking 2022. <https://www.bworldonline.com/infographics/2022/06/15/454863/world-competitiveness-ranking-2022/>
- Dvignun, A. O., Datsii, O. I., Levchenko, N. M., Shyshkanova, G. A., & Dmytrenko, R. M. (2022). Rational use of fresh water as a guarantee of agribusiness development in the context of the exacerbated climate crisis. *Science and Innovation*, 18(2), 85-99. <https://doi.org/10.15407/scine18.02.085>
- Erfan, E. & Labetska, M. (2023). Study of the influence of global technologies on the development of the world market of transport services. *Economy and society*. <https://doi.org/10.32782/2524-0072/2023-56-27>
- Fedorova, Yu. (2021). Innovative information technologies in personnel training and management. *Adaptive Management. Theory and Practical Economics*, 11. [https://doi.org/10.33296/2707-0654-11\(22\)-11](https://doi.org/10.33296/2707-0654-11(22)-11)
- Havrysh, O. & Karpenko, I. (2023). Innovation as an imperative for the competitiveness of transnational corporations in global markets. *Economic Synergy*, 136-150. <https://doi.org/10.53920/ES-2023-1-11>
- Humeniuk, I. (2023). The impact of information technologies on the country's economy. *Inclusion and society*, 5-9. <https://doi.org/10.32782/2787-5137-2023-2-1>
- Istomina, A. I., Vinogradova, M. V., Lukyanova, A. V., Dobrovolskaya, O. P., & Prodanova, N. A. (2020). Leadership in the digital age: A new strategy for the competitiveness of countries and macro regions. *Revista ESPACIOS*, 41(07), 21. <https://www.revistaespacios.com/a20v41n07/20410721.html>
- Kniaz, S. & Bohiv, J. & Georgiadi, N. (2020). Business planning of innovative projects: essence of technologies, advantages and disadvantages. *Marketing and Management of Innovations*, 759.
- Kovalko, O., Eutukhova, T., & Novoseltsev, O. (2022). Energy-related services as a business: Eco-transformation logic to support the low-carbon transition. *Energy Engineering: Journal of the Association of Energy Engineering*, 119(1), 103-121. <https://doi.org/10.32604/EE.2022.017709>
- Kulyavets, V. (2021). International competitiveness of Ukraine in the conditions of globalization: problems and prospects. *Adaptive Management Theory and Practical Economics*, 11. [https://doi.org/10.33296/2707-0654-11\(22\)-04](https://doi.org/10.33296/2707-0654-11(22)-04)
- Makarenko, S. & Likanova, A. & Pleshivtseva, A. (2021). Implementation of innovative personnel management technologies. *Economy and society*. <https://doi.org/10.32782/2524-0072/2021-33-36>
- Mechanic, O. V. (2006). Competitiveness as a socio-economic category: essence, structure, classification, foundations of formation. *Formation of market relations in Ukraine*, (10), 27-34
- Mohylina, L. & Orekhova, A. & Khromushyna, L. (2022). Use of innovative IT technologies for HR management. *Economy and society*. <https://doi.org/10.32782/2524-0072/2022-44-56>
- Nesterenko, V. & Moroz, A. & Bolotova, T. (2022). Innovations in agricultural entrepreneurship and their impact on competitiveness. *Problems and prospects of entrepreneurship development*, 130-137. <https://doi.org/10.30977/PPB.2226-8820.2022.28.130>
- Pavlenko, I. A. (2007). *Innovative entrepreneurship in the transformational economy of Ukraine*. Kyiv: KNEU.
- Poluneev, Yu. V. (2010). Competitiveness of the country as an economic category and development strategy. *Current problems of international relations*, 94(Part II), 189-204.
- Popov, O. O., Iatsyshyn, A. V., Iatsyshyn, A. V., Kovach, V. O., Artemchuk, V. O., Gurieiev, V. O., Kiv, A. E. (2021). Immersive technology for training and professional development of nuclear power plants personnel. *Paper presented at the CEUR Workshop Proceedings*, 2898 230-254.
- Popov, O. O., Kyrylenko, Y. O., Kameneva, I. P., Iatsyshyn, A. V., Iatsyshyn, A. V., Kovach, V. O., Kiv, A. E. (2022). The use of specialized software for liquid radioactive material spills simulation to teach students and postgraduate students. *Paper presented at the CEUR Workshop Proceedings*, 3085 306-322.

- Samoilenko, O. M., Batsurovska, I. V., Samoilenko, O. O., & Dotsenko, N. A. (2018). Implementation of the model of master's training for educational and scientific activities in the conditions of mass open distance courses. *Information technologies and teaching aids*, 64(2), 197-220.
- Shvydanenko, O. A. (2007). *Global competitiveness: theoretical and applied aspects*. Kyiv: KNEU.
- Slavkov, M. & Kalantaevska, O. & Gubar, O. (2023). The influence of innovative management on the competitiveness of enterprises in the modern world. *Economy and society*. <https://doi.org/10.32782/2524-0072/2023-56-95>
- Taranenko, I. V., & Taranenko, Yu. K. (2011). Econometric models of the influence of globalization and innovation factors on the competitiveness of countries. *Development Strategy of Ukraine* (economics, sociology, law), 4(1), 153-158.
- Tymoshenko, M. & Sayenko, V. & Shashina, M. & Slavkova, O. (2023). The influence of industry 4.0 on the modeling of scenarios of energy development of the economies of developing countries. *Financial and credit activity problems of theory and practice*, 1, 336-350. <https://doi.org/10.55643/fcaptp.1.48.2023.3941>
- Voinova, E. (2018). Global competitiveness of the country: justification of the category, types, factors and consequences. *World economy and international economic relations*, 16, 36-45.
- Yudina, E. (2016). Modeling the impact of technological innovations on the growth of production efficiency. *The Bulletin of the Dnipropetrovsk University. Series: Management of Innovations*, 272. <https://doi.org/10.15421/191630>
- Zhalilo, Ya.A., Basiluk, Ya.B., Belinska, Ya. V., et al. (2005). *Competitiveness of the economy of Ukraine in the conditions of globalization*. Kyiv: NISD.