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Editorial address:
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Socio-economic inequality of the population in Ukraine: Challenges and prospects for ensuring resilience

Tetiana Sergiienko

PhD in Political Sciences, Associate Professor
National University "Zaporizhzhia Polytechnic"
69063, 64 Zhukovsky Str., Zaporizhzhia, Ukraine
https://orcid.org/0000-0002-4654-9248

Olena Krainik*

PhD in Economic Sciences, Associate Professor
National University "Zaporizhzhia Polytechnic"
69063, 64 Zhukovsky Str., Zaporizhzhia, Ukraine
https://orcid.org/0000-0002-9787-0744

Abstract. Socio-economic inequality in Ukraine, in the face of new challenges, particularly military aggression, has become especially pressing, as these factors significantly exacerbate existing imbalances in income and access to basic resources. These challenges not only increase poverty levels but also create additional barriers to equal access to education, healthcare services, and other essential goods. Research on this issue is crucial for shaping a resilience-focused development strategy and achieving social justice, which is fundamental to the harmonious development of society. The aim of this study was to examine socio-economic inequality in Ukraine within the context of contemporary global and domestic challenges, as well as to substantiate promising approaches to enhancing resilience by reducing this inequality. To achieve this objective, a wide range of methods was employed, including analysis and synthesis, statistical analysis, a comparative approach, as well as generalisation and forecasting techniques. According to research by the National Institute for Strategic Studies (NISS), the level of socio-economic inequality in Ukraine is relatively lower than in most European Union countries. High levels of unreported income may distort the true picture of inequality. Key contributing factors include income disparities, unequal access to education, healthcare, and housing. Military aggression has significantly worsened the situation, leading to rising poverty and declining economic activity. Addressing socio-economic inequality requires comprehensive social policy reforms, particularly the strengthening of targeted assistance and the promotion of economic recovery, ensuring equal opportunities for all citizens. The practical significance of this study lies in its potential to support the formulation of effective policy decisions and the development of programmes aimed at reducing socio-economic inequality, particularly in the context of military aggression

Keywords: income inequality; poverty; social policy; economic recovery; military aggression; support for vulnerable groups; demographic groups

Introduction

The issue of socio-economic inequality constantly attracts the attention of researchers and policymakers, as it concerns fundamental questions about the existence of different social strata and classes, as well as the fair and efficient distribution of income and resources. Studying this phenomenon is particularly important in times of economic instability, when the need to develop new approaches to addressing it becomes more pressing. The analysis of the causes, manifestations, and consequences of inequality was based on the work of leading scholar. S. Asefa & W.-C. Huang (2020), in their study, examined the political economy of inequality, specifically analysing the relationship between political structures and economic inequality in the United States and the global context. The authors

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*Corresponding author

highlighted that political institutions and power structures can significantly influence economic inequality, as they shape the economic environment that determines access to resources and opportunities. They also emphasised that reducing inequality requires the implementation of policies that support inclusive economic development.

The researcher I.P. Campomanes (2024) analysed the political economy of inequality, mobility, and redistribution. The author investigated how political and economic structures impact the level of socio-economic inequality and mobility within society. He emphasised that redistribution policies can have a significant effect on reducing inequality, though this depends on the effectiveness of the institutions regulating these processes. The researcher highlighted the importance of social and economic reforms aimed at improving equal opportunities for all social strata. D. Acemoglu (2024) published a paper in which he examined various approaches to measuring economic inequality in the United States. The author stressed the importance of a deep understanding of the underlying causes of this inequality and noted that measurement methods can significantly alter the interpretation of the situation. Despite this, the general trend of increasing inequality remains evident, which requires effective political responses to address it. D. Acemoglu (2024) also emphasised that institutional structure can have a profound impact on income distribution in society, which is a key aspect of understanding economic inequality. Along with the contributions of other researchers, it is important to highlight the work of Ukrainian scholars who adapt these approaches to the national context. V. Kostiuk (2021) in her article examined global trends in economic inequality and their impact on socio-economic development. She noted that inequality has a wide range of consequences for the development of economies, and its reduction is a key condition for ensuring stability and growth. The researcher also emphasised the need for inclusive approaches to addressing inequality in a global context. V. Opalko (2019) focused on the significance of inclusive development for ensuring sustainable economic growth. She stated that achieving this requires considering not only economic but also social, cultural, and political aspects that contribute to the inclusion of various social groups in the process of economic progress.

This approach creates more equal conditions for all segments of the population, which is fundamental for the stability and development of the economy. N. Vorobyova *et al*. (2023) in their collective work examined the concepts of inclusive economic development in the context of globalisation and digitalisation. They emphasised the importance of integrating socially vulnerable groups, such as women, youth, and people with disabilities, into the process of economic growth. In their conclusions, the researchers highlighted that creating accessible and equal opportunities for all members of society not only reduces social inequality but also improves the overall economic situation of the country, contributing to stable development. These works underscore the significance of inclusive strategies in economic development and provide valuable recommendations for policymakers and economists on how to ensure more equal access to resources and opportunities for all social groups. In addition to the inclusive approach, an important area of research is the relationship between socio-economic inequality and poverty in Ukraine with direct foreign investments. This issue is actively explored by Z. Chernousova & O. Malyavina (2021), who studied the impact of investments on social inequality in Ukraine, noting that the influx of foreign capital does not always lead to a reduction in inequality. The researcher I. Shapoval (2024) examined in detail various methods of measuring economic inequality and emphasised the importance of studying the fundamental causes of this inequality to develop effective political strategies. She noted that for a deeper understanding of this phenomenon, it is necessary to consider a broad range of factors, from economic to social, that can significantly influence the level of inequality in the country. Many aspects related to the effective institutional framework for reducing socio-economic inequality remain underdeveloped. The relevance of these studies significantly increases in the context of current challenges, such as military aggression and economic instability. The aim of this study was to conduct a comprehensive analysis of socio-economic inequality among the population in Ukraine, identify its main challenges and prospects, as well as to develop practical recommendations that will contribute to its reduction and ensure the country's resilience in the face of these pressing challenges.

Literature review

Global challenges, such as the uneven distribution of wealth, climate change, demographic shifts, and digital transformation, are shaping a new reality that requires a comprehensive approach. Economic growth is no longer the sole indicator of progress, as without considering social aspects, it can exacerbate inequality. This motivates scholars to turn to fundamental research that allows for a deeper understanding of the interconnections between economic, social, and political processes. The analysis of classical works is essential, as they help to formulate effective strategies for overcoming inequality and ensuring sustainable development. For example, the theory of S. Kuznets (1955) predicted that as the economy develops, the level of inequality first increases, and then starts to decrease through wealth redistribution. However, empirical evidence has not consistently confirmed this idea: economic development does not always lead to a reduction in inequality. Inequality can increase, stabilise, or even decrease, and in some cases, the poorest segments of society may experience an improvement in their economic status. Later, the researcher argued that inequality in society depends on economic development (Kuznets, 1966). As a result, at the initial stages of economic growth, inequality may increase, but over time it begins to decrease due to wealth redistribution. The ideas of S. Kuznets (1955; 1966) gained support from scholars such as R. Perotti (1996) and R. Barro (2000), who agreed

that over time economic development reduces the level of inequality. However, the theory of S. Kuznets also had its critics, such as K. Deininger & L. Squire (1998), who argued that the growth of inequality could be caused by other factors and also emphasised the negative consequences of inequality for economic growth and social stability.

The theory of S. Kuznets (1955) initiated a new phase of understanding social inequality through the lens of economic processes, opening up wide opportunities for further research. However, modern scientific studies of inequality phenomena show that its growth is not always related to economic development. Y. Ding (2004) suggested that despite stable economic growth worldwide, socio-economic inequality has increased in many countries. This confirmed the diversity of views on socio-economic inequality, where some scholars see it as a positive phenomenon if it is based on natural differences, such as various human qualities and talents. In other cases, inequality is considered a negative phenomenon caused by socio-economic and political factors.

In the global context, there is a reverse trend – inequality not only does not decrease, but also grows significantly. This issue was thoroughly researched by T. Piketty (2014), a French economist. T. Piketty showed that global economic growth was accompanied by an uneven distribution of profits. He argued that the accumulation of capital by a narrow group of people outpaced the growth rates of the economy, leading to increased inequality. J. Robinson (2009), in his work alongside other researchers, analysed the relationship between political institutions and economic inequality, stating that a country's institutional structure significantly influences the level of inequality. They concluded that effective institutions that ensure fair access to economic opportunities can substantially reduce inequality. Socio-economic inequality is not only an empirical phenomenon but also a theoretical issue that requires analysis of its causes and consequences. Classical works contain fundamental concepts that help form new approaches to resource distribution and solving the inequality problem in the 21st century.

Materials and Methods

One of the main methods used was analysis and synthesis, which allowed for generalising existing data and identifying key factors of inequality. For this purpose, data obtained from official statistical sources were used, such as reports from the State Statistics Service of Ukraine (Summary table of..., 2023; Summary table of..., 2024) and inflation reports from the National Bank of Ukraine for 2023-2024 (Inflation Report, n.d.). Statistical data processing played a key role in measuring the level of inequality in the economy. One of the key tools was the Gini index, which measures income or wealth distribution inequality in society (Gini index 2020 in the world, 2021). These indicators reflected the degree of social and economic inequality in Ukraine, as well as the changes in these indicators in the context of current crisis situations, such as the full-scale invasion (Deepening income inequality..., 2023).

The use of a comparative approach allowed for the comparison of socio-economic indicators of Ukraine with those of European Union countries. Germany, Ireland, France, and Spain were chosen for comparison due to their diversity in economic development, social policies, and geographical location within the EU. Germany is the leading economy in the EU and demonstrates exemplary social policies with a high level of spending on social protection. Its example was of particular interest for assessing the potential for adapting such approaches in Ukraine. Ireland was selected for its dynamic economic development, innovation-driven growth, and low-income inequality, coupled with high per capita income growth. France is known for its historical focus on social equality and effective state support for vulnerable populations. Spain was chosen for its extensive experience in overcoming high unemployment rates and implementing effective labour market programs. The selection of these countries enabled both an examination of various approaches to addressing socio-economic issues and the identification of best practices adaptable to Ukraine. For the analysis, data from 2023 were used, as this provided up-to-date information on the state of the economy and the social sphere amid current challenges. The study compared indicators such as the Gini index (Gini index in Ukraine..., 2024), income levels, the projected change in the Gini index by 2029, and global inequality (Degenhard, 2024). This comparison helped identify both strengths and weaknesses in the socio-economic policies of various EU countries, which can be useful for developing strategies to improve the social and economic situation in Ukraine.

Forecasting methods played a crucial role in analysing future trends in socio-economic inequality in Ukraine, considering the impact of external factors. For this purpose, predictive models were used, based on data provided by the National Institute for Strategic Studies (NISS), which allowed for assessing the potential impact of current social and economic processes on poverty and inequality levels. Additionally, publications from the National Institute for Strategic Studies (NISS) (Analytical reports, n.d.) were used, containing up-to-date reports and forecasts on the development of the economy and social processes in Ukraine. Reports from international organisations such as the World Bank (Documents & Reports, n.d.), the international monetary fund (IMF) (Documents & Reports – Advanced Search, n.d.), and Eurostat (n.d.) were also consulted. These reports provided comparative data on inequality levels and social policies in different countries, which allowed for evaluating Ukraine's position in a global context. The analysis of such data helped to identify key trends and challenges faced by countries striving for socio-economic stability and the reduction of inequality.

In addition to statistical data, significant attention in the study was given to the use of various sources that enable a comprehensive analysis of socio-economic inequality in Ukraine. Among the key sources was research that deepens the understanding of the impact of war on

socio-economic inequality. A valuable source was the study by L. Artemenko *et al*. (2023) on food security in Ukraine amid military aggression. The article by S. Zavhorodnia (2024) provided a relevant analysis of inequality issues in Ukraine in the context of global and internal changes. Another important contribution to the study was the article by O. Dmytrenko & S. Demchenko (2018), which examined the relationship between institutional changes and social inequality in Ukraine. These sources facilitated a well-founded and comprehensive analysis of socio-economic inequality in Ukraine, considering its interconnection with other national and international factors. This allowed for the formulation of recommendations for improving social policy in Ukraine, taking into account the specifics of national conditions and needs.

Results and Discussion

The issues of deepening economic inequality are not only characteristic of developing countries but also of developed countries in the European Union. In Ukraine, according to the Ukraine Report 2023 (2023), income inequality is relatively low compared to EU countries, with a Gini index indicating a certain level of equality. However, the standard of living in Ukraine is significantly lower than in countries with higher income polarisation, such as Germany, Ireland, France, or Spain (Table 1).

Table 1. Comparison of the level of economic inequality in Ukraine and EU countries according to the Gini index

Country	Gini index, 2023	Income level (on average)	Forecast change in Gini index by 2029	Global inequality
Ukraine	0.25	Low – Medium	Increase by 0.01 (+3.85%)	High
Germany	0.31	High	Remain stable	Medium
Ireland	0.28	High	Remain stable	Low
France	0.29	High	Remain stable	Medium
Spain	0.34	Medium – High	Increase by 0.02 (+5.8%)	High

Note: the Gini index measures the level of socio-economic inequality: 0 — perfect equality, 1 — maximum inequality
Source: created by the authors based on the Gini coefficient of equivalised disposable income by age (n.d.)

It is also worth noting that official statistical data may not fully reflect the real situation due to the high level of shadow economy activity particularly among high-income groups. In this context, social inequality serves as a crucial indicator of socio-economic activity at various levels: the micro level (within individual communities and households), the macro level (at the national level), and the mega level (in the context of global processes). It directly affects societal stability, economic efficiency, and the level of social trust. These factors are critical for ensuring resilience and integration into a globalised world, where technological advancements and economic globalisation continue to reshape social structures. Table 2 illustrates the rise in economic inequality at the global level between 2020 and 2024, where the wealthiest 1% of the population have acquired a significant share of new wealth. This exacerbates social inequality and presents new challenges in ensuring fair access to resources and opportunities for all.

Table 2. Distribution of new wealth among the wealthiest and the rest of the world's population (2020-2024)

Year	Share of new wealth acquired by the top 1% (%)	Share of new wealth acquired by the other 99% (%)	Additional indicators
2020	55%	45%	The wealthiest 1% own 43% of global financial assets
2021	60%	40%	Around 46% of the world's population live below the poverty line
2022	63%	37%	13% of global GDP is concentrated among 3,000 families
2023	65%	35%	The assets of the five wealthiest individuals increased by 114%
2024	>70%	<30%	The top 1% own more than the poorest 95% of the population

Source: created by the authors based on O. Topchii (2023), A. Kryzhnyi (2024)

The table illustrating the distribution of new wealth between the wealthiest 1% and the remaining 99% of the world's population from 2020 to 2024 reflects a significant increase in global economic inequality. In 2020, the top 1% acquired 55% of new wealth, while the remaining 99% received only 45%. This highlights the substantial concentration of wealth within a small group, a defining characteristic of economic inequality. The year 2020 marked a period of global economic turbulence due to the COVID-19 pandemic, which significantly affected resource distribution. By this time, the wealthiest 1% already owned 43% of global financial assets, emphasising the vast concentration of wealth among the richest. In 2021, the share of new wealth acquired by the wealthiest 1% rose to 60%, while the remaining 99% received just 40%. This rise in inequality occurred during the post-pandemic economic recovery, when the majority of new wealth remained in the hands of the affluent. Additionally, approximately 46% of the world's

population remained below the poverty line, underscoring the need for better resource distribution. By 2022, the wealthiest 1% had gained 63% of new wealth, while the rest of the population received only 37%. This continuation of the inequality trend is further evidenced by the fact that just 3,000 families controlled 13% of global GDP, demonstrating the extreme concentration of economic wealth within a small demographic. In 2023, the share of new wealth acquired by the top 1% increased to 65%, leaving only 35% for the rest of the population. The assets of the five wealthiest individuals grew by 114%, further enriching the ultra-rich and deepening global economic inequality (Zavhorodnia, 2024). Forecasts for 2024 indicate a continued rise in inequality, with the wealthiest 1% now acquiring over 70% of new wealth, while the remaining population receives less than 30%. This trend reflects a widening gap between the richest and the poorest. Projections suggest that the top 1% will control more than 95% of the wealth owned by the poorest segments of society, a critical indicator of global economic disparity. These findings highlight how the digital divide and unequal access to technology continue to exacerbate socio-economic inequality, posing new challenges to ensuring resilience and providing economic opportunities for broader population groups.

It is important to note that economic inequality in Ukraine and the EU, the table below provides key indicators for the period 2021-2023, along with a forecast for 2024 (Degenhard, n.d.). As shown in Table 3, the disparity in economic inequality between Ukraine and the European Union is significant, particularly in terms of the Gini Index, which remains consistently low in Ukraine while indicating greater inequality in EU countries. However, the standard of living in Ukraine is considerably lower than in most EU countries, emphasising the need to address inequality and improve the country's socio-economic conditions. It is projected that the Gini Index in Ukraine will steadily increase between 2024 and 2029, rising by 0.01 points (+3.85%) to reach 0.27 by 2029. The Gini coefficient measures income inequality on a scale from 0 (complete equality) to 1 (complete inequality). The data presented are an excerpt from Statista (Gini index in Ukraine..., 2024), which includes key market indicators (KMI) covering macroeconomic, demographic, and technological environments in over 150 countries worldwide.

Table 3. Comparison of socio-economic inequality in Ukraine and the EU

Indicator	Ukraine (2021-2024)	EU (2021-2024)	Forecast for Ukraine (2025)
Gini Index (%)	25.6-27.0	29.6-30.2	26.5-27.0
Standard of living	Lower	Higher	Same
Main issue	Shadow economy	Income polarisation	Shadow economy
Households at risk of poverty	>50% (2024)	Data not specified	>50% (forecast)

Source: developed by the authors based on J. Degenhard (2024)

Experts from the M. Ptoukha Institute for Demography and Social Studies of the National Academy of Sciences of Ukraine have noted that income differentiation is one of the key factors of social inequality, as it directly impacts access to goods and services for different population groups (Libanova, 2012). Households with low incomes are forced to spend a larger portion of their finances on meeting basic needs, particularly on food purchases, creating a significant gap in consumption capabilities between the poor and the wealthy. The latter can afford a much wider range of goods and services, including non-food items.

According to the inflation report by the National Bank of Ukraine for 2021-2023 and the inflation report for October 2024 (Inflation Report, n.d.), the situation in Ukraine remains challenging due to the full-scale invasion by Russia, ongoing geopolitical tensions, rising inflation, and fluctuations in global energy prices. These factors have contributed to increasing prices for essential goods, making access to basic needs more difficult for many households. Additionally, there has been a significant increase in the number of households unable to afford essential goods due to economic hardships caused by martial law, pushing them to the brink of poverty. During this period, many families have been forced to cut spending on essential products, severely limiting their ability to maintain a decent standard of living. These circumstances indicate that martial law not only exacerbates economic challenges but also deepens social inequality, increasing the level of despair among the poorest segments of the population. Further details are provided in Table 4, which compares economic conditions and poverty levels in Ukraine from 2021 to 2024.

Table 4. Comparison of economic conditions in Ukraine (2021-2024)

Year	Economic conditions	Poverty level	Issues with access to essential goods	Impact of the war	Notes
2021	Stable economic conditions following the pandemic	High	No critical issues with access to goods	None	Transitional period after the pandemic, although poverty remained high
2022	Outbreak of war, sharp decline in incomes	Increased significantly	High inflationary costs for essential goods	Significant	Sharp income decline, many households lost their sources of income

Table 4. Continued

Year	Economic conditions	Poverty level	Issues with access to essential goods	Impact of the war	Notes
2023	Worsening economic situation due to the war	Rising	More households unable to afford essential goods	Very high	Martial law exacerbated access to basic needs, increasing social inequality
2024	Economic instability, rising inflation	Rising	Further deterioration in access to basic goods	High	Economic difficulties due to the war and global economic factors

Source: developed by the authors

This table provided an overview of the economic conditions in Ukraine between 2021 and 2024, highlighting the increase in poverty and issues with access to essential goods, which were exacerbated by the war. The war significantly complicated access to essential goods due to infrastructure destruction, supply chain restrictions, and inflation, leading to rising prices for basic items. This increased the poverty rate, as a large portion of the population was unable to afford the necessary goods (Dukhnytskyi, 2020). The inflation surge notably impacted poverty levels in the country, which can be clearly traced through a linear graph showing changes in these indicators (Fig. 1).

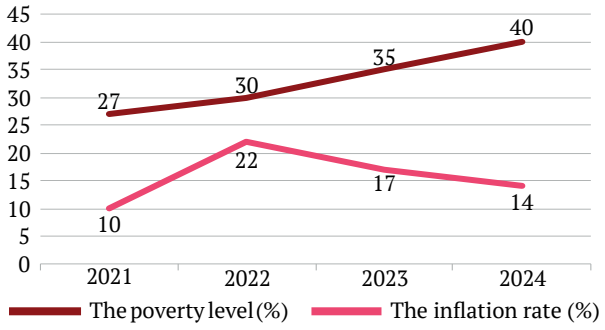

Figure 1. Changes in the inflation rate and poverty level in Ukraine (2021-2024)

Source: developed by the authors based on the Inflation Report (n.d.)

The line graph depicting the inflation rate and changes in the poverty level in Ukraine from 2021 to 2024 revealed a significant correlation between rising inflation and the deterioration of the socio-economic situation. In 2021, the inflation rate in Ukraine remained moderate, but by 2022, due to the onset of the war and economic hardships, inflation began to rise sharply. This had a direct impact on poverty, as rising prices for essential goods and services made it more difficult for a large portion of the population to access basic needs. In 2023, inflation reached its peak, further exacerbating poverty levels. The dynamics of the graph illustrate how economic difficulties and high inflation lead to a significant increase in the number of people living below the poverty line. The forecast for 2024 suggests a slight slowdown in inflation, but the poverty rate remains high, indicating the prolonged negative impact of the economic crisis on the population's well-being.

The graph highlighted the urgency of finding comprehensive solutions to stabilise the economic situation in Ukraine, including the implementation of effective anti-crisis measures and support for the most vulnerable segments of the population during economic instability. The deepening socio-economic inequality is a direct consequence of the war, as a large portion of the population has experienced a significant decrease in income, making access to vital resources more difficult. Issues with the economic accessibility of food and essential goods amid constant inflation and war only exacerbate the situation. Income reductions and rising poverty remain key challenges for most citizens of Ukraine, further intensifying social tension and lowering the quality of life under martial law. One of the crucial aspects of food security is Ukraine's position in the global food security index (GFSI) (Ukraine ranks 52nd..., n.d.). This index serves as a benchmark model used to analyse and assess the strengths and weaknesses of national food systems, as well as to identify threats to food security in different countries (Table 5).

Table 5. Global food security index of Ukraine and its components

Year	Economic accessibility	Physical accessibility	Quality & safety	Natural resources & resilience	Global index	World position
2020	74.4	51.6	75.3	50.3	63	54
2021	73.9	51.8	71.9	49.3	62	58
2022	66.6	48.1	71.0	48.2	61	61
2023	65.0	47.5	70.0	47.0	60	63
2024	64.0	46.0	68.0	45.5	56.4	52

Source: developed by the authors based on L. Artemenko *et al.* (2023)

The data presented in the table take into account the latest trends, including the decline in indicators related to the economic accessibility of food and natural resources, as well as the growing challenges in ensuring food quality and safety, reflecting the current situation in Ukraine (Artemenko *et al.*, 2023). This table provides an overview of Ukraine's economic conditions in the context of the global food security index, highlighting the rise in poverty and

issues with access to essential goods, which have worsened due to the war. The war has significantly complicated access to basic resources and deepened social inequality, leading to increased poverty and inflation. The decline in household incomes and their ability to secure essential goods has made these issues even more pressing under martial law. For assessing the spread of energy poverty, key aspects include indicators of utility bill arrears and access to energy services. According to the Unified State Register of Debtors (Over 700 thousand..., 2024), before the full-scale armed aggression of the Russian Federation against Ukraine, the level of household debt for utility services stood at 18.8%. As of 1 January 2022, the debt for housing and communal services amounted to UAH 81.6 billion, rising to UAH 120 billion by 1 January 2023, including debts in the temporarily occupied territories. Additionally, according to the Unified State Register of Debtors, the number of enforcement proceedings for utility service arrears in Ukraine increased from 344,565 in January 2021 to 701,051 in July 2024 (Over 700 thousand..., 2024). This 37% increase since the beginning of the full-scale war is a critical indicator of the economic difficulties faced by households.

From January 2021 to February 2022, a significant increase was recorded – from 344,565 to 512,359 enforcement proceedings (a rise of 48%). This indicates a difficult economic situation, which was already being exacerbated by the war, affecting the population's ability to meet financial obligations. By February 2023, the number of debts had reached 593,373 cases, demonstrating the continuation of a negative trend. Following this, the number of debts increased by a further 11.2%, reaching 659,684 cases by January 2024. This highlights the persistent growth of payment difficulties amid a prolonged economic crisis. However, the most substantial increase in debt was recorded in mid-2024, when the number of cases reached 701,051. This 6.3% rise suggests that the economic situation is not only failing to stabilise but is also continuing to deteriorate under ongoing war conditions and social changes (Hirak, 2023). According to 2024 data, the highest concentration of debtors is in the Dnipropetrovsk region, where over 100,000 enforcement proceedings have been recorded, accounting for 14.3% of the total. This is followed by the Kharkiv and Donetsk regions, with 94,800 and 79,700 cases, respectively (Fig. 2).

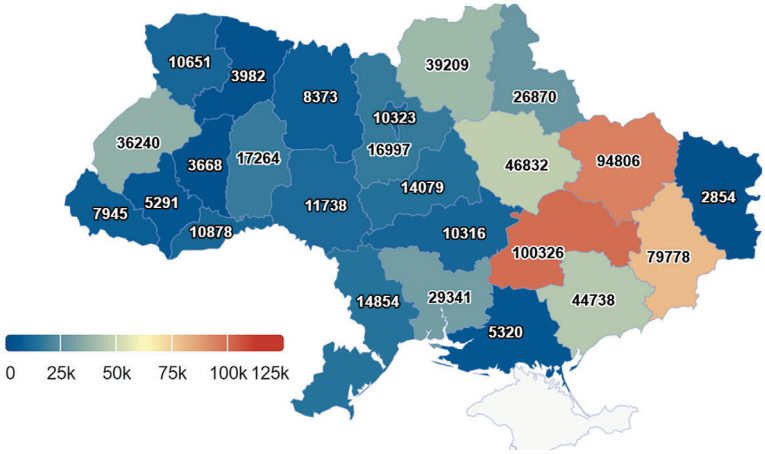

Figure 2. Highest number of utility debtors as of July 2024

Source: compiled by the authors based on Over 700 thousand utility debts recorded in Ukraine (2024)

According to the latest data, 36.9% of all utility debts in Ukraine are attributed to unpaid heating bills, amounting to 258.8 thousand cases. Water supply debts follow at a significant distance, accounting for 18.6% or 130.2 thousand cases. Electricity debts rank third, with 67.9 thousand cases or 9.7%. Additionally, Ukrainians have outstanding debts for other utility services: housing maintenance – 67.1 thousand cases (9.6%), gas supply – 59.7 thousand cases (8.5%), and waste collection – 7.6 thousand cases (1.1%). In 15.6% of cases, it was not possible to determine which specific service was the subject of the debt, totalling approximately 109 thousand cases (Over 700 thousand..., 2024). Further details can be found in Table 6, which compares economic conditions and poverty levels in Ukraine from 2021 to 2024, highlighting key challenges in ensuring resilience.

Table 6. Growth of utility debts in Ukraine (2021-2024)

Year	Total number of cases (thousands)	Heating (%)	Water supply (%)	Electricity (%)
2021	344,565	36.9	18.6	9.7
2022	512,359	38.0	19.0	10.0
2023	593,373	36.9	18.6	9.7
2024	701,051	36.9	18.6	9.7

Source: compiled by the authors based on Over 700 thousand utility debts recorded in Ukraine (2024)

The identified changes in utility debts serve as a clear indicator of how war and economic difficulties are worsening Ukrainians' access to essential utility services, creating conditions for energy poverty and deepening socio-economic inequality in the country. The analysis indicates that socio-economic inequality in Ukraine remains a significant issue, exacerbated by the consequences of war and economic crisis. Rising poverty, inflation, and declining household incomes have severely restricted access to basic goods and services. The increasing utility debt burden and declining indicators in the global food security index highlight the growing severity of these challenges. Gaps in government spending on agricultural research and technological development are hindering the sustainable growth of key economic sectors crucial for ensuring food security. Addressing these challenges requires a comprehensive approach, including improvements in social policy, resource accessibility, and economic reforms to ensure resilience and sustainable development both during the war and in the post-war recovery period (Putytskyi, 2024).

The prospects for ensuring Ukraine's sustainable development require a comprehensive approach that includes several strategic directions to overcome socio-economic inequality and improve the population's quality of life (Arabadzhyiev & Sergiienko, 2022). One of the key areas is the reform of social policy, aimed at improving access to education, healthcare, and utility services for the most vulnerable groups. Investing in the development of agricultural infrastructure and scientific-technical research is essential for enhancing food security and ensuring the sustainable growth of the agricultural sector (Voronkova & Metelenko, 2021). In parallel, it is necessary to strengthen economic stability, reduce poverty levels, and support small and medium-sized enterprises through investment incentives. A crucial element for ensuring resilience and sustainable development is Ukraine's integration into international economic and trade partnerships, which will contribute to the advancement of the national economy.

In the context of war, particular attention should be given to enhancing risk adaptability and ensuring stable supplies of essential resources such as food and energy (Sergiienko, 2023). A crucial step is the continued regulation of food prices, financial support for farmers, and the development of emergency food security strategies. The implementation of the Food Security Strategy until 2030 will contribute to making food more accessible to all social groups and reducing household expenditures (Draft Resolution of the Cabinet of Ministers of Ukraine, 2020). In the field of energy security, it is essential to maintain subsidies for energy resources, promote building thermal modernisation, and invest in renewable energy sources. These measures will help lower energy costs for the population, ensuring resilience not only for economic stability but also for reducing socio-economic inequality, which tends to worsen during armed conflicts. Research from the 21st century confirms that inequality is intensifying due to globalisation, technological advancements, and transformations in socio-economic structures. Unlike classical theories that suggested economic growth would automatically reduce inequality, modern studies emphasise that inequality can persist or even deepen due to unequal access to resources, particularly in times of crisis. The issue of socio-economic inequality in Ukraine, especially in the face of current challenges such as military aggression, remains a crucial subject for study, as confirmed by numerous academic works. A key aspect is comparing inequality levels in Ukraine with those in other European countries, which helps to better understand the global context and specific nature of these processes. According to data from the National Institute for Strategic Studies (NISS) (Manifestations of economic inequality…, 2024), the level of socio-economic inequality in Ukraine is lower than in most European Union countries. However, the high level of the shadow economy complicates an accurate assessment of the real situation.

These conclusions align with the findings of E.M. Libanova (2020), who pointed out that inequality in Ukraine is deepening due to economic instability and the lack of effective social protection mechanisms. She emphasised the importance of creating transparent income assessment systems to foster a better understanding of social barriers and inequalities. Agreeing with this perspective, the results of the study also showed that socio-economic inequality is most pronounced in access to essential social goods such as education and healthcare. In this context, V. Zaiats's (2024) research is particularly important, as he assessed the level of deep deprivation poverty among households, poverty based on nutrition criteria, and subjective poverty, as well as how these factors have changed due to the ongoing military conflict. His findings confirmed the unprecedented impact of war on the poverty of the population, leading to significant long-term economic consequences and a worsening of the social-economic situation of citizens. This aligns with the conclusions of O. Chubka *et al*. (2022), who noted that the war not only worsened the economic situation but also created new barriers to accessing social benefits, exacerbating existing issues of social inequality. These facts underscore the need to develop effective strategies to reduce social inequality, particularly in terms of access to education and healthcare, in the context of a persistent economic crisis.

Regarding the factors contributing to inequality, it is important to note that, according to T. Piketty (2022), globalisation and technological progress significantly contribute to the expansion of socio-economic disparities. The author emphasised that countries with high levels of economic development are facing new inequality challenges due to automation and the impact of technologies on the labour market. This argument aligns with the conclusions of studies on the impact of modern technologies on social opportunities in Ukraine. An interesting study is by A. Korinek & J. Stiglitz (2021), in which they examined the impact of globalisation and artificial intelligence on economic development in countries, which can also be applied to the context of Ukraine. They noted that the availability

of high-tech tools can not only stimulate development but also create additional barriers to equal access to opportunities, especially in countries with unstable economic situations. In the context of military aggression, it is important to consider the economic consequences for social groups with lower income levels. M. Sverdian (2019) pointed out that the increase in poverty as a result of conflicts is a global trend, and Ukraine is no exception. The findings confirmed that the war has significantly worsened the socio-economic situation of the population, particularly in the areas of active combat.

The differences between the works of other authors may be attributed to the wide range of methods they applied, including statistical analysis, which allowed for a deeper assessment of the impact of contemporary global challenges on social inequality in Ukraine. While other studies, such as the work of C.B. Frey & M. Osborne (2023), focused on general forecasts regarding the impact of technologies on the future of work, this research specifically examined how these factors affect economic inequality in a country undergoing a crisis. Contemporary studies also highlighted technological changes that create new forms of work and income, where certain groups gain significant advantages through access to the latest technologies and skills. This leads to an increase in inequality, as those with this knowledge and resources are presented with even greater opportunities, while others are left on the periphery of the economic process. O. Bulatova *et al*. (2023) noted that global asymmetries in socio-economic development are deepened under the influence of technoglobalism. Proponents of technoglobalism, along with supporters of the Schumpeterian approach to explaining the determinants of economic development, believe that economic growth is driven by breakthrough innovations and the concept of "creative destruction" of jobs. They suggested that certain vulnerable segments of the labour market may suffer from technological modernisation and the digital transformation of the economy, but in the long run, these asymmetries will be eliminated. In contrast, opponents of technoglobalism, concerned not only with the future impact of digital technologies, such as artificial intelligence, on the labour market but also with the socio-economic consequences of technological changes, argue that retrospective evaluation of the impact of disruptive technologies on social inequality will further deepen existing barriers. The digital divide may influence income inequality in two main ways. Information and communication technologies (ICT) contribute to economic growth by creating opportunities to fight poverty and develop social and human capital. Reducing inequality in access to and use of these technologies can ease access to essential resources and information, enabling businesses to improve productivity and increase earning opportunities. However, when cutting-edge technologies are primarily available only to wealthier segments of the population, a higher level of digital literacy may lead to an uneven distribution of income, increasing social inequality.

This phenomenon can be explained through the "Matthew effect", which occurs when those with access to resources and technology are able to use them to further expand their advantages. Conversely, those who lack access to such technologies lose opportunities for social and economic advancement. The Matthew effect is a socio-economic phenomenon that describes a situation where "the rich get richer". It means that people or organisations that already possess certain advantages or resources are able to further strengthen their positions by using these advantages to foster additional growth. Those who lack access to the necessary resources or opportunities face difficulties and often remain on the periphery of the economic process, thereby exacerbating inequality. In the context of digital transformation, the Matthew effect can lead to the "digital divide", which further divides social groups and countries based on their ability to adapt to and leverage new technologies for their development. N. Roztocki *et al*. (2019) highlighted that this phenomenon emphasises the importance of equitable distribution of resources and access to technology, as those who have access to innovations can use them to strengthen their socio-economic positions, while others are left behind in the development process. Research confirmed that socio-economic inequality is a multifaceted phenomenon that manifests in various forms across all countries, regardless of their level of development. Inequality arises as a result of both economic processes and social conditions that have been formed over a long period of time. It is historically rooted and remains an inherent part of socio-economic life.

In a broader sense, social inequality refers to the existence of conditions where different groups within a population have unequal access to resources, opportunities, and benefits such as education, healthcare, and social security. This phenomenon is deepened by the digital divide, which further restricts access to opportunities for economic and social growth, creating new challenges for policies and development strategies. In this context, inequality should be viewed as a relative measure of socio-economic development, based on various criteria such as income, consumption levels, access to social services, or opportunities for career advancement. Therefore, discussions on this research highlight the importance of creating resilient policies to reduce socio-economic inequality in Ukraine, particularly in the context of military aggression. Research from various sources has provided a deeper understanding of the context of social and economic inequality at the global level and helped identify inequality-related issues within Ukraine. The results of international studies emphasised significant global trends that directly impact Ukraine's socio-economic situation.

Conclusions

The research revealed that economic growth in the 21st century does not always lead to a reduction in social inequality, as predicted by S. Kuznets' theory. There has been a trend towards increasing inequality, as confirmed

by T. Piketty's studies. While globalisation and technological advancements create new development opportunities, they also deepen socio-economic divides by limiting access to resources and cutting-edge technologies. Technological innovations, particularly in the context of digital transformation, demonstrate the "Matthew Effect", which shows that access to information and communication technologies can be a driving force for economic development, but at the same time increases the gap between social groups.

In Ukraine, despite a relatively low level of inequality according to the Gini index, there are serious challenges, including a high level of the shadow economy and a low standard of living. The war, rising inflation, infrastructure destruction, and problems with the supply of essential goods have complicated access to basic needs for many households, leading to a significant increase in poverty. One of the key indicators of economic hardship is the debt for utility services. In 2024, the level of debts increased significantly, indicating a deterioration in the population's ability to pay and growing socio-economic inequality. The war and economic crisis have worsened food security, further driving poverty levels up. The research objective – to study socio-economic inequality in Ukraine in the context of contemporary challenges – has been achieved. To address these issues, comprehensive measures need to be implemented to improve social policy and ensure access to essential services and resources. Investment in the agricultural sector, development of scientific and technological research, energy resilience, and food security strategies are crucial. Additionally, it is necessary to enhance adaptability to risks, such as disruptions in the supply of essential goods and energy resources. Future research prospects include studying the effectiveness of policies aimed at combating energy poverty during martial law and analysing the social and economic consequences of utility service debts. Also important are studies on mechanisms that can reduce debt levels without worsening the living conditions of the population. In the future, research will focus on specific aspects of inequality in Ukraine, which have significantly intensified due to the full-scale invasion, worsening access to essential social goods and creating new challenges for social justice in the country.

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Conflict of Interest

None.

References

[1] Acemoglu, D. (2024). *Clarifying America's great inequality debate*. Retrieved from https://surl.li/hjcirj.

[2] Analytical reports. (n.d.). Retrieved from https://niss.gov.ua/publikacii/analitichni-dopovidi.

[3] Arabadzhyiev, D., & Sergiienko, T. (2022). Theoretical and methodological principles of monitoring social cohesion and stability in the modern realities of Ukraine (on the example of the Zaporizhzhia region). *Regional Studies*, 30, 35-39. doi: 10.32782/2663-6170/2022.30.5.

[4] Artemenko, L., Marynenko, N., Kramar, I., & Hatz, L. (2023). Food security of Ukraine in the conditions of military aggression: State and prospects. *Social and Economic Problems and the State*, 1(28), 115-128. doi: 10.33108/sepd2023.01.115.

[5] Asefa, S., & Huang, W.-C. (Eds.). (2020). *The political economy of inequality: U.S. and global dimensions*. Kalamazoo: W.E. Upjohn Institute.

[6] Barro, R. (2000). Inequality and growth in a panel of countries. *Journal of Economic Growth*, 5(1), 5-32. doi: 10.1023/A:1009850119329.

[7] Bulatova, O., Reznikova, N., & Ivashchenko, O. (2023). Digital divide or digital inequality? New dimensions of global asymmetries of socio-economic development and international trade in the context of technoglobalism. *Bulletin of Mariupol State University. Series: Economics*, 25, 45-57. doi: 10.34079/2226-2822-2023-13-25-45-57.

[8] Campomanes, I.P. (2024). The political economy of inequality, mobility, and redistribution. *Journal of Macroeconomics*, 79, article number 103585. doi: 10.1016/j.jmacro.2023.103585.

[9] Chernousova, Z., & Malyavina, O. (2021). Study of the dependence of inequality and poverty in Ukraine with foreign direct investment. *Economic Scope*, 176, 145-149. doi: 10.32782/2224-6282/176-26.

[10] Chubka, O., Skoropad, I., & Putytskyi, A.I. (2022). Conceptualization of approaches to the interpretation of the definition of "inequality", its types, manifestations, and causes of emergence. *Financial and Credit Activity Problems of Theory and Practice*, 5(46), 463-476. doi: 10.55643/fcaptp.5.46.2022.3910.

[11] Deepening income inequality in the context of armed aggression against Ukraine. (2023). Retrieved from https://surl.li/yumihf.

[12] Degenhard, J. (2024). *Gini index in Ukraine from 2014 to 2029*. Retrieved from https://www.statista.com/forecasts/1165120/gini-index-forecast-in-ukraine.
[13] Deininger, K., & Squire, L. (1998). New ways of looking at old issues: Inequality and growth. *Journal of Development Economics*, 57(2), 259-287. doi: 10.1016/S0304-3878(98)00099-6.
[14] Ding, Y. (2004). Social and economic disparities. *Environment and Development*, 1.
[15] Dmytrenko, O.V., & Demchenko, S.A. (2018). Institutional environment for reproduction of social inequality. *Bulletin of V.N. Karazin Kharkiv National University Economic Series*, 93, 162-169. doi: 10.26565/2311-2379-2017-93-17.
[16] Documents & Reports – Advanced Search. (n.d.). Retrieved from https://documents.worldbank.org/en/publication/documents-reports/docadvancesearch.
[17] Documents & Reports. (n.d.). Retrieved from https://documents.worldbank.org/en/publication/documents-reports.
[18] Draft Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Food Security Strategy for the Period up to 2030". (2020, November). Retrieved from https://www.me.gov.ua/Documents/Detail?lang=uk-UA&id=33eec8aa-b768-4234-8f5d-7014601cf6e7&title.
[19] Dukhnytskyi, B. (2020). Actual problems in food supplying to the world's population. *Ekonomika APK*, 27(6), 91-97. doi: 10.32317/2221-1055.202006091.
[20] Eurostat. (n.d.). Retrieved from https://ec.europa.eu/eurostat.
[21] Frey, C.B., & Osborne, M. (2023). Generative AI and the future of work: A reappraisal. *The Brown Journal of World Affairs*, 30(1).
[22] Gini coefficient of equivalised disposable income by age. (n.d.). Retrieved from https://ec.europa.eu/eurostat/databrowser/view/ilc_di12/default/table?lang=en.
[23] Hirak, H. (2023). *Debt pit: What threatens those who do not pay for utilities*. Retrieved from https://ua.korrespondent.net/articles/4706163-borhova-yama-scho-zahrozhuie-tym-khto-ne-platyt-za-komunalku
[24] Inflation Report. (n.d.). Retrieved from https://bank.gov.ua/ua/monetary/report.
[25] Korinek, A., & Stiglitz, J. (2021). *DP15772 Artificial intelligence, globalization, and strategies for economic development*. Retrieved from https://cepr.org/publications/dp15772.
[26] Kostiuk, V. (2021). Inequality in the modern world. In *The III International scientific and practical online conference "Current issues, priority areas and strategies for the development of Ukraine"* (pp. 63-69). Kyiv: ITTA.
[27] Kryzhnyi, A. (2024). *The world's 500 richest people have reached a wealth of over $10 trillion this year*. Retrieved from https://epravda.com.ua/finances/500-naybagatshih-lyudey-svitu-dosyagli-bagatstva-ponad-10-trilyoniv-cogo-roku-801540/.
[28] Kuznets, S. (1955). Economic growth and income inequality. *The American Economic Review*, 45(1), 1-28.
[29] Kuznets, S. (1966). *Modern economic growth: Rate, structure, and spread*. New Heaven: Yale University Press.
[30] Libanova, E.M. (2020). *Poverty in Ukraine: Methodology, techniques and practice of analysis*. Uman: Sochinskyi M.M.
[31] Libanova, E.M. (Ed.). (2012). *Inequality in Ukraine: Scale and opportunities for influence*. Kyiv: Ptoukha Institute for Demography and Social Studies of the National Academy of Sciences of Ukraine.
[32] Manifestations of economic inequality in Ukraine in the context of ensuring sustainability (2024). Retrieved from https://niss.gov.ua/doslidzhennya/sotsialna-polityka/proyavy-ekonomichnoyi-nerivnosti-naselennya-v-ukrayini-v-konteksti.
[33] Opalko, V.V. (2019). Socio-economic inequality and the formation of a new paradigm of inclusive development in Ukraine. *Black Sea Economic Studies*, 38(2), 63-69.
[34] Over 700 thousand utility debts recorded in Ukraine. Where do the most debtors live? (2024). Retrieved from https://opendatabot.ua/analytics/debts-2024-7.
[35] Perotti, R. (1996). Growth, income distribution, and democracy: What the data say. *Journal of Economic Growth*, 1(2), 149-187. doi: 10.1007/BF00138861.
[36] Piketty, T. (2014). *Capital in the twenty-first century*. Cambridge: Harvard University Press.
[37] Piketty, T. (2022). *A brief history of equality*. Cambridge: Harvard University Press.
[38] Putytskyi, A.I. (2024). Proposals and recommendations for reducing socioeconomic inequality in Ukraine through the prism of education. *Business Inform*, 9, 61-68. doi: 10.32983/2222-4459-2024-9-61-68.
[39] Robinson, J. (2009). The political economy of inequality. *Economic Research Forum*, 493.
[40] Roztocki, N., Soja, P., & Weistroffer, H.R. (2019). The role of information and communication technologies in socioeconomic development: Towards a multi-dimensional framework. *Information Technology for Development*, 25(2), 171-183. doi: 10.1080/02681102.2019.1596654.
[41] Sergiienko, T. (2023). Ukrainian policy in the context of sustainable economic development in the post-war period. In *Prospective directions of scientific and practical activity* (pp. 351-359). Sherman Oaks: GS Publishing Services. doi: 10.51587/9798-9866-95921-2023-011.
[42] Shapoval, I. (2024). Economic inequality: Concept and approaches to measurement. *History of Economics and Economic Thought in Ukraine*, 57, 426-447. doi: 10.15407/ingedu2024.57.426.

[43] Summary table of consumer price indices in 2023. (2023). Retrieved from https://index.minfin.com.ua/ua/economy/index/inflation/2023/
[44] Summary table of consumer price indices in 2024. (2024). Retrieved from https://index.minfin.com.ua/ua/economy/index/inflation/2024/.
[45] Sverdian, M. (2019). Economic inequality: Measurement and evaluation. *Economics Studies*, 1(23), 77-84.
[46] Topchii, O. (2023). *In two years, 63% of the world's new wealth has ended up in the hands of 1% of people – Oxfam*. Retrieved from https://surli.cc/yfznsz.
[47] Ukraine ranks 52nd in the global food security index. (n.d.). Retrieved from https://ukrseeds.org.ua/ukra%D1%97na-zaima%D1%94-52-e-m%D1%96stse-v-globalnomu-%D1%96ndeks%D1%96-prodovolcho%D1%97-bezpeki.
[48] Ukraine Report 2023. (2023). Retrieved from https://enlargement.ec.europa.eu/ukraine-report-2023_en.
[49] Vorobyova, N., Havryliuk, S., & Lytvynova, T. (2023). Some aspects of inclusive development economy of Ukraine. *Scientific Notes of "KROK" University*, 1(69), 29-37. doi: 10.31732/2663-2209-2022-69-29-37.
[50] Voronkova, V., & Metelenko, N. (Eds.). (2021). *Sustainable development management of industrial enterprises: Theory and practice*. Zaporizhzhia: Helvetyka Publishing House.
[51] Zaiats, V. (2024). Non-monetary criteria of poverty under the influence of crisis phenomena. *Economics and Society*, 68. doi: 10.32782/2524-0072/2024-68-42.
[52] Zavhorodnia, S. (2024). *Economic inequality among the population of Ukraine in the context of ensuring resilience*. Retrieved from https://niss.gov.ua/sites/default/files/2024-02/az_eknerivnist_19022024.pdf.

Соціально-економічна нерівність населення в Україні: виклики та перспективи забезпечення стійкого розвитку

Тетяна Сергієнко
Кандидат політичних наук, доцент
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0000-0002-4654-9248

Олена Крайнік
Кандидат економічних наук, доцент
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0000-0002-9787-0744

Анотація. Соціально-економічна нерівність в Україні в умовах нових викликів, зокрема військової агресії, набуває особливої актуальності, оскільки ці фактори поглиблюють існуючі дисбаланси в доходах та доступі до основних ресурсів. Ці виклики не лише підвищують рівень бідності, але й створюють додаткові бар'єри для рівного доступу до освіти, медичних послуг та інших життєво необхідних благ. Дослідження цієї проблеми є важливим для формулювання стратегії стійкого розвитку, а також для досягнення соціальної справедливості, яка є основною умовою для розвитку суспільства. Метою даного дослідження було вивчення соціально-економічної нерівності населення України в контексті сучасних глобальних та внутрішніх викликів, а також обґрунтування перспективних шляхів для забезпечення стійкого розвитку на основі зниження цієї нерівності. Для досягнення поставленої мети використано широкий спектр методів, серед яких аналіз і синтез, статистичний аналіз, порівняльний підхід, а також методи узагальнення та прогнозування. За результатами досліджень Національного інституту стратегічних досліджень виявлено, що рівень соціально-економічної нерівності в Україні є порівняно нижчим, ніж у більшості країн Європейського Союзу. Висока тінізація доходів може спотворювати реальну картину цієї нерівності. Серед основних чинників, що сприяють нерівності, є дисбаланси в доходах, нерівний доступ до освіти, медичних послуг та житлових умов. Військова агресія значно погіршила ситуацію, сприяючи зростанню бідності та зниженню економічної активності. Для подолання соціально-економічної нерівності необхідно здійснити реформу соціальної політики, зокрема посилити адресну допомогу і сприяти економічному відновленню, що дозволить забезпечити рівні можливості для всіх громадян. Практична цінність дослідження полягає в здатності підтримувати формулювання ефективних політичних рішень та розробку програм, спрямованих на зменшення соціально-економічної нерівності, особливо в умовах військової агресії

Ключові слова: нерівність доходів; бідність; соціальна політика; економічне відновлення; військова агресія; підтримка вразливих груп; демографічні групи

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The impact of artificial intelligence on the transformation of enterprise business processes

Kateryna Andriushchenko*

Doctor of Economic Sciences, Professor
Kyiv National Economic University named after Vadym Hetman
03057, 54/1 Beresteysky Ave., Kyiv, Ukraine
https://orcid.org/0000-0002-6274-5310

Sviatoslav Marchuk

Postgraduate Student
Kyiv National Economic University named after Vadym Hetman
03057, 54/1 Beresteysky Ave., Kyiv, Ukraine
https://orcid.org/0009-0004-4217-1075

Abstract. The rapid advancement of artificial intelligence (AI) fundamentally transformed the business environment by optimising management processes, enhancing operational efficiency, and generating new challenges for enterprises. This necessitated a comprehensive analysis of its impact on the transformation of business processes. The objective of the study was to examine the influence of AI on the transformation of business processes in enterprises of various sizes, identify primary directions of its application, and assess development prospects. The study was grounded in the use of systemic analysis, comparative analysis, case study method, and statistical data analysis. Scientific publications, corporate reports, analytical materials, and practical implementation cases were processed. The findings revealed that the adoption of AI significantly increased the efficiency of business processes in large enterprises through operational automation, customer interaction personalisation, and enhanced market forecasting. In the financial sector, machine learning algorithms reduced fraud rates and expedited document processing, consistent with global practices in banks such as JPMorgan Chase, Mizuho, and SMFG. In retail, improvements in recommendation system accuracy were observed, as reported by global companies like Amazon and Netflix, where personalisation contributed to increased conversion rates. Manufacturing enterprises reported optimised logistics and reduced operational costs due to AI implementation. Furthermore, enterprises actively explored the potential of generative AI in marketing, product development, and employee productivity, yielding results aligned with international experience, including the deployment of GitHub Copilot, which improved the speed and quality of software development. The practical value of the study lay in the applicability of its results for executives, analysts, and consultants to enhance digital transformation strategies and improve enterprise competitiveness

Keywords: digital transformation; machine learning; business analytics; process automation; corporate management; customer experience; ethical challenges

Introduction

The dynamic growth of digital technologies and globalisation processes at the beginning of the 21st century profoundly altered the business environment, particularly through the integration of AI. AI transformed business processes by means of automation, big data analysis, personalisation, and innovative approaches to management. These developments enhanced operational efficiency, accelerated enterprise adaptation to market changes, and created competitive advantages. However, alongside new opportunities, AI introduced challenges linked to data quality, ethical concerns, financial costs, and the shortage of skilled personnel. Investigating the influence of AI on

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*Corresponding author

business processes proved essential for understanding its role in ensuring long-term sustainability of enterprises in the digital era.

The impact of AI on the transformation of business processes received considerable attention from scholars and analytical firms. Scientific literature examined the implementation of AI in managerial, operational, and strategic functions, while identifying potential integration challenges. O.O. Chernysheva *et al*. (2024) studied the use of AI for business process automation and its influence on enterprise efficiency. It was emphasised that machine learning algorithms enabled substantial optimisation of operations, reduced time expenditure on routine tasks, and improved market trend forecasting. The authors concluded that AI integration in enterprise management systems led to a 25-30% decrease in administrative expenses.

D. Oriekhov (2024) investigated the influence of AI on modern enterprise management, focusing on key AI components such as machine learning, deep learning, natural language processing (NLP), computer vision, robotics, expert and recommendation systems, autonomous systems, and intelligent agents. These technologies were examined in relation to production management, financial planning, marketing strategies, and human resource management. The study demonstrated that AI adoption contributed to enhanced operational efficiency and enterprise competitiveness. A. Beheshti *et al*. (2023) analysed the application of generative AI in business process management (BPM) and proposed the concept of ProcessGPT, a solution based on the generative pre-trained transformer (GPT) architecture. This technology facilitated automation, augmentation, and enhancement of business processes through large-scale data analysis and decision-making support. It was noted that traditional BPM systems targeted rigid processes, whereas ProcessGPT adapted to dynamic, complex environments such as finance, healthcare, and education. The study demonstrated this technology's capacity to reduce costs and increase enterprise efficiency through machine learning and NLP integration. A case from the banking sector illustrated how ProcessGPT enabled data management automation and decision support in complex informational ecosystems. The research confirmed that generative AI could significantly transform business processes by reducing human involvement in routine operations and improving enterprise analytical capabilities.

The automation of software project management through artificial intelligence opened new opportunities for optimising business processes and enhancing organisational efficiency. As noted by K. Bhavsar *et al*. (2019), the application of business process reengineering (BPR) in combination with machine learning (ML), deep learning (DL), natural language processing, and speech recognition (SR) technologies had not only eliminated routine operations but also improved risk forecasting, resource allocation, and decision-making accuracy. This approach facilitated the transformation of software engineering management (SEM), resulting in cost reduction, improved product quality, and increased corporate competitiveness. The integration of AI into project management allowed organisations to adapt more swiftly to changes in the business environment by employing advanced algorithms for data analysis and strategic planning.

The use of AI and machine learning in predictive business process management unveiled further potential for improving process control. M. Abbasi *et al*. (2024) conducted a systematic literature review on the integration of AI and machine learning in business process modelling, with a focus on process enhancement. The authors highlighted that predictive business process management involved the utilisation of analytical methods to anticipate changes in workflows based on historical data, thereby enabling organisations to not only optimise existing processes but also adapt them to dynamic market conditions. Two core stages were emphasised: data analysis and refinement of process models, followed by radical process adjustments based on derived analytical insights. Furthermore, the role of process mining in identifying bottlenecks and enhancing operational execution was underlined, as well as the potential of deep learning algorithms to improve forecasting precision. Thus, the studies illustrated the substantial potential of AI in business process modelling, while also stressing the need for further exploration into the integration of predictive process management into corporate governance strategies. Accordingly, the objective of the article was to investigate the influence of AI development on the transformation of business processes across enterprises of varying scales – from small businesses to global corporations.

Materials and Methods

The study on the impact of artificial intelligence on the transformation of enterprise business processes was based on the comprehensive application of a range of scientific methods and the analysis of a wide spectrum of information sources. Both theoretical and empirical research approaches were employed to examine the specifics of AI integration into corporate governance, production processes, marketing strategies, and customer interaction.

During the research, a combination of theoretical and empirical analysis methods was used. Systemic analysis was applied to assess general trends in the use of AI in business and its influence on the economic performance of enterprises. For this purpose, scientific publications and reports by international analytical firms such as McKinsey, Gartner, and Deloitte were summarised to identify key development trajectories of AI technologies and major challenges faced during integration (The state of AI..., 2023; Bittman *et al*., 2024; Deloitte, 2024). Practical cases of AI implementation by international companies were examined, including Amazon (personalised recommendation systems and supply chain management), Netflix (user preference analysis and content personalisation), Tesla (autonomous control and production optimisation), and IBM (process automation and cognitive analytics), as well as Ukrainian enterprises such as Monobank (chatbots and financial scoring

algorithms) and Rozetka (intelligent recommendation systems and logistics optimisation). This analysis required the examination of corporate reports, public corporate materials, and statistical data on the efficiency of AI deployment (Verbivska, 2023; Artificial intelligence in..., 2024; Yurasov, 2024). Structural-functional analysis was used to evaluate the role of AI in various enterprise activities, including business process automation, service personalisation, marketing strategy formation, human resource management, and production optimisation (Bhavsar *et al.*, 2019; Jain & Jain, 2023; Chernysheva *et al.*, 2024). Furthermore, content analysis was conducted on scientific articles, international conference reports, and corporate documentation, enabling a comprehensive assessment of the global level of AI technology implementation (Beheshti *et al.*, 2023; Zavrazhnyi, 2023; Abbasi *et al.*, 2024).

Among empirical methods, particular emphasis was placed on statistical data analysis, which enabled the quantitative assessment of AI technology's effect on business process efficiency. Public statistical reports by IBM and Deloitte were processed, providing concrete data on the economic effects of implementing machine learning and predictive algorithms (How much does a business..., 2021; The state of AI..., 2023; Deloitte, 2024). The case study method was used for in-depth analysis of AI technology application in leading international companies. Cases examined included JPMorgan Chase, which utilised AI for legal process automation; Mizuho Financial Group, which optimised financial operations; and companies such as Amazon and Nike, which actively integrated generative AI to create personalised products and improve supply chains (Peng *et al.*, 2023; Beheshti *et al.*, 2023; Oriekhov, 2024). Additionally, expert surveys were conducted, including the analysis of publications by leading analysts in the field of digital transformation and the evaluation of feedback from executives implementing AI. Expert opinions from Forrester Research and Boston Consulting Group were reviewed regarding the prospects and risks of AI integration into the business environment (Sizing the prize..., n.d.; Bittman *et al.*, 2024; Otsokolich, 2024).

To identify potential trends in AI's future development and its long-term influence on the entrepreneurial environment, forecasting methods were applied. Findings from McKinsey Global Institute concerning the future use of generative AI in marketing, product development, and business process automation were taken into account (The state of AI..., 2023; Deloitte, 2024; Chakraborty *et al.*, 2024). Additional reports from analytical firms such as Gartner, Deloitte, McKinsey, and Forrester Research were used to evaluate the predicted business impact of AI technologies (The state of AI..., 2023; Bittman *et al.*, 2024; Deloitte, 2024). Corporate reports by Tesla, IBM, and Netflix illustrated real-world applications of AI in business cases (Verbivska, 2023; Yurasov, 2024; Artificial intelligence in..., 2024). Official publications from research centres, governmental institutions, and open data platforms were also reviewed, offering insight into the scope and peculiarities of AI applications (Regulation (EU) 2016/679 of the European Parliament and of the Council, 2016; We created a catalogue..., 2020; The AI ecosystem..., 2024). Through the integrated application of these methods, a coherent vision was formed regarding the impact of AI on the transformation of business processes, as well as the prospects for further technological development in the corporate sector.

Results and Discussion

Artificial intelligence had already become an indispensable component of modern entrepreneurship, having transformed key aspects of business processes such as automation, analytics, innovation, and personalisation. This evolution had occurred gradually, having reshaped approaches to management, product development, and customer engagement. According to Deloitte (2024), the use of generative AI had been rising sharply, promoting innovation and strengthening competitiveness. In its report, Gartner emphasised the role of composite AI and edge computing in reshaping business processes (Bittman *et al.*, 2024). These trends illustrated the significance of AI integration in business. The historical application of AI began with the automation of routine tasks. During the 1980s and 1990s, AI-based software enabled cost reductions and enhanced the efficiency of business operations. Since the early 2000s, powerful analytical tools had emerged, allowing market trend forecasting and customer behaviour prediction. As reported, generative AI had been widely used in creative activities, including design and content creation. For instance, Nike applied generative AI in developing personalised sports footwear designs, while The New York Times implemented AI algorithms to automate the generation of visual content and headlines based on reader preference analysis.

The impact of AI had been especially prominent in the optimisation of business processes, where its deployment contributed to increased efficiency and automation of routine tasks. Robotic Process Automation (RPA) enabled the execution of repetitive operations such as document processing, supply chain management, and financial auditing with minimal human involvement. According to the analysis by O.O. Chernysheva *et al.* (2024), Amazon utilised AI to enhance logistics and customer behaviour analysis, supporting demand forecasting and inventory optimisation. Beyond Amazon, significant applications of AI in business process optimisation had been demonstrated by Tesla and IBM. Tesla applied AI for automated quality control in manufacturing and for enhancing autopilot functionality, which improved safety and transport efficiency. IBM Watson assisted businesses in optimising data analytics and decision-making in the financial and healthcare sectors, simplifying the processing of large volumes of information. Among Ukrainian enterprises, Rozetka and Monobank stood out for their active integration of AI into business processes. Rozetka employed AI algorithms to personalise product recommendations, thereby boosting

sales and customer satisfaction. Monobank, Ukraine's first mobile-only bank, actively implemented AI to automate transaction processing, credit scoring, and customer interaction through chatbots and voice request analysis systems (Verbivska, 2023).

The role of AI in financial services and healthcare had been considerable. As stated by L. Verbivska (2023), banks utilised algorithms to detect fraud and personalise financial products. Monobank employed AI to analyse transactions and identify suspicious activities, reducing fraud levels and improving financial security. AI supported credit scoring, fraud detection, and personalised financial offerings. According to Deloitte (2024), over 60% of banks used AI algorithms to analyse large datasets and enhance decision-making accuracy. Notable adopters included JP-Morgan Chase, which automated legal document analysis with AI, reducing processing time and costs; and Japanese institutions such as Mizuho Financial Group and Sumitomo Mitsui Financial Group, which actively integrated computerised systems to replace manual labour and improve operational efficiency (Artificial intelligence in…, 2024). In the Ukrainian context, Sense Bank applied AI in information security, employing biometric identification to verify clients and prevent fraud related to social engineering techniques (Yurasov, 2024). In healthcare, AI facilitated the analysis of medical imagery and treatment prediction, significantly enhancing service quality. Notably, Google Health developed a deep learning-based algorithm capable of diagnosing breast cancer with higher accuracy than traditional mammogram analysis, supporting earlier detection and more effective treatment. Furthermore, AI enabled the creation of advanced diagnostic tools capable of forecasting disease progression, thereby supporting timely patient care and reducing the burden on medical staff (Sizing the prize…, n.d.).

AI had substantially transformed key dimensions of entrepreneurship by reshaping approaches to management, production, customer service, and new product development. It enabled automation of processes that had previously required significant human time input, including data processing, supply chain monitoring, and inventory management. According to Gartner, companies employing RPA achieved operational cost reductions of 20-30% within the first year of implementation (Bittman *et al.*, 2024). The insurance firm Encova Insurance actively adopted RPA to improve efficiency and enhance customer service. As reported by UiPath (Encova Insurance…, n.d.), the company automated its customer retention process, saving up to 25 working hours weekly by collecting data from customer files and sending agents recommendations regarding policyholders at risk of cancellation. Global Bilgi (n.d.), a leading business process outsourcing company, implemented RPA to optimise invoice processing. This facilitated faster workflows, reduced errors, and lowered operational costs. Through automation of repetitive tasks by software robots, the company improved both efficiency and accuracy in its operations.

The study by H. Makhova & V. Vostriakova (2022) comprehensively addressed the significance of artificial intelligence (AI) as a key instrument of digital transformation in entrepreneurship, highlighting that its implementation had become a necessity for contemporary enterprises across various industries. Two principal directions of AI's influence on business were identified: the first concerned cost optimisation through the automation of routine and repetitive processes, which enabled reductions in operational expenses and the mitigation of human factor risks; the second related to revenue growth, achieved by means of offer personalisation and enhanced customer experience. The study placed emphasis on changes driven by the COVID-19 pandemic, which had significantly accelerated the adoption of AI technologies, assisting enterprises in adapting to crisis conditions by improving supply chains, optimising inventory management, and enhancing the efficiency of customer engagement. The application of AI in key sectors of the economy was analysed, including automotive manufacturing, financial services, retail, and telecommunications. The authors underscored that the potential and specificity of AI deployment varied considerably across industries. An important conclusion of the study was a warning regarding the necessity of a strategic approach to AI adoption, with mandatory risk assessment – particularly with regard to the balance between automation and the human factor. Excessive automation could result in service quality degradation, erosion of customer trust, and the loss of competitive advantages. Overall, the study's findings and conclusions reflected the positive prospects of AI integration, substantiated by practical examples and empirical research from international companies. In contrast, the current research found no clear confirmation that the COVID-19 pandemic had significantly accelerated the development of AI technologies. Unlike H. Makhova & V. Vostriakova (2022), the present authors were inclined to consider the rapid advancement of AI as a consequence of evolutionary changes in related domains of digital technology development – including big data analytics, refinement of machine learning models, and adjacent innovations.

Another significant area of AI application involved customer interaction personalisation. Machine learning algorithms enabled companies to analyse consumer behaviour in real time, generating customised offers and recommendations. This substantially increased customer satisfaction and fostered loyalty. Research showed that following the deployment of AI-driven customer analytics systems, the accuracy of recommendations improved markedly. For instance, Amazon reported a 35% increase in purchases resulting from its use of deep learning algorithms in recommendation engines. Similarly, Netflix claimed that AI-based personalised suggestions helped retain 80% of its users by delivering individualised content monthly. In order for AI to accurately predict customer preferences, large and diverse datasets needed to be leveraged. Key data sources included purchase and viewing history, indicating which items or content the user had previously explored or

acquired. Activity time analysis – such as identifying when purchases or viewing typically occurred – also proved beneficial. Additional indicators encompassed click maps revealing which pages the user had visited and interacted with most, as well as device type and location, whether smartphone, laptop, tablet, or another medium. Another critical data source comprised user ratings and reviews of viewed products or services. To further refine predictive accuracy, it was considered effective to factor in the social networks and preferences of users with similar interests by analysing comparable profiles. These inputs enabled machine learning algorithms to construct predictive models capable of recommending products with a high likelihood of appealing to specific customers. This not only enhanced the customer experience but also significantly increased revenue for companies implementing such systems (Bittman *et al.*, 2024).

Another essential domain of AI application was the creation of innovative products and services. Generative AI models such as ChatGPT, Claude, and others had been actively used to automate content development, design, and even programming. These technologies allowed companies to reduce production costs and substantially improve product quality. Research by McKinsey Global Institute (The state of AI..., 2023) demonstrated that generative AI could dramatically improve the efficiency of marketing content by lowering production costs and increasing personalisation and effectiveness at scale. A separate marketing executive survey indicated that AI implementation resulted in a 7% reduction in overhead marketing expenses while simultaneously boosting customer satisfaction by 7%, indirectly suggesting an improvement in perceived product and content quality. These findings confirmed that AI-powered content generation enabled companies to produce higher-quality materials at lower cost, thereby improving business outcomes.

In the fields of design and manufacturing, substantial benefits of AI had also been recorded. H.A. Habeeb *et al*. (2023) proposed an AI-based design optimisation method that combined generative design with additive manufacturing. The findings indicated that such automation reduced production costs, improved productivity, and delivered significant enhancements in both quality and output. Accordingly, the implementation of AI in design and engineering processes led to resource savings and better final product quality through more optimal solutions. In software development processes, the use of AI-powered programming assistants also confirmed reductions in labour intensity and improvements in code quality. For example, a large-scale randomised study involving over 4,000 developers demonstrated that the AI-driven tool GitHub Copilot increased developer productivity by approximately 26%. Code written with the assistance of Copilot exhibited better functionality, improved readability, and a higher rate of test pass success, as well as receiving more approval during code reviews (Peng *et al.*, 2023).

AI also exerted a notable impact on human resource management. AI algorithms facilitated the automation of recruitment processes by analysing candidate CVs and selecting those best suited to vacant roles. In addition, AI was employed for employee training and development. Tools based on AI enabled the creation of personalised training programmes that accounted for individual needs and weaknesses. The application of AI significantly transformed approaches to human resource management by influencing recruitment, learning, and development procedures. Its use automated routine tasks, such as CV sorting, interview scheduling, and employee data management. This substantially reduced information processing time and allowed HR professionals to focus on strategic initiatives. AI algorithms supported more effective recruitment by analysing large volumes of data and identifying candidates that most closely matched job requirements, thereby increasing overall recruitment efficiency (Top 10 modern methods..., 2024). Beyond hiring, AI played a crucial role in personalised employee training and development. Machine learning-based tools enabled the design of individual training programmes that addressed each employee's needs and shortcomings, improving both productivity and job satisfaction. However, alongside these advantages, certain risks persisted. For instance, AI algorithms could inherit biases if trained on unrepresentative or subjective datasets, potentially resulting in discrimination against particular candidate groups (Holei & Drik, 2023).

AI had also been utilised for automated résumé screening. Among notable international firms adopting such solutions was Unilever, where the AI-based HireVue platform facilitated video interviews and candidate evaluations, enabling the processing of up to 13,000 applications annually and significantly reducing recruitment time. Similar technologies had been applied by Hilton, achieving a 90% reduction in hiring duration (Recruitment of the future..., 2024). In Ukraine, applicant tracking systems (ATS) and other AI technologies for recruitment had only begun to gain traction. Some companies had already started employing automated systems for résumé analysis and candidate-job matching (Top 10 modern methods..., 2024), although large-scale adoption remained in its early stages.

AI had considerably transformed production processes by integrating into the Industry 4.0 framework. Through AI algorithms, enterprises could predict equipment malfunctions, optimise supply chains, and lower production expenses. Specifically, sensor data analysis enabled the early identification of potential issues, helping to prevent costly downtime. This was confirmed by research from Danfoss, which reported that predictive maintenance supported by condition monitoring served as a powerful tool for optimising equipment performance and reducing maintenance costs (Predictive maintenance..., n.d.). Furthermore, Festo highlighted that AI-based solutions – such as predictive maintenance – could detect faults before they caused significant failures, thereby avoiding unplanned downtimes, lowering servicing costs, and enhancing company productivity (Blume, 2024). Ethical considerations surrounding AI implementation also represented a vital element of its business integration. Ensuring algorithm transparen-

cy, avoiding bias, and maintaining data privacy standards were key factors affecting customer and partner trust. Organisations were advised to develop responsible AI usage policies that took into account potential social and economic consequences. Table 1 summarised the key aspects of AI's impact on entrepreneurship:

Table 1. Summary of AI's impact on key aspects of entrepreneurship

Area of impact	Description	Example of application
Business process automation	Cost reduction and efficiency increase through automation of routine tasks	Use of RPA (robotic process automation) for document processing
Personalisation	Individual customer approach through behavioural analysis	Recommendation systems of Amazon, Netflix
Analytics and forecasting	Prediction of market trends and customer behaviour	Banking algorithms for fraud detection
Product development	Creation of innovations using generative AI models	Use of ChatGPT, Claude, Gemini for automated text generation
Healthcare	Improved diagnostics and patient condition forecasting	AI-based analysis of medical imagery
Human resource management	Optimisation of recruitment and training processes	AI résumé analysis algorithms, personalised training
Marketing	Creation of targeted advertising campaigns	User data analysis for targeting
Manufacturing	Process optimisation and fault prediction	Industry 4.0 tools

Source: Compiled by the authors based on K. Zavrazhnyi (2023), O.O. Chernysheva *et al*. (2024), D. Oriekhov (2024), V. Petrenko (2024)

The implementation of AI in entrepreneurial processes offered significant prospects but simultaneously introduced a series of challenges affecting the efficiency and ethical integration of such technologies. Key obstacles encountered during AI adoption and potential approaches for overcoming them warranted further examination. One of the most critical challenges concerned data quality. Data formed the foundation for AI performance, and any inaccuracies, duplications, or inconsistencies could substantially affect outcomes. According to an IBM report, the average cost of a data breach for companies amounted to $4.24 million, underscoring the importance of robust data governance for avoiding financial losses (How much does a business…, 2021). Research by Deloitte revealed that over 40% of companies experienced difficulties handling large volumes of data during AI integration (Deloitte, 2024). Barriers such as restricted data access, fragmented information, or processing delays hindered the creation of reliable AI models. These issues could be mitigated through the implementation of data standardisation, cleansing, and governance systems to ensure data suitability for AI use.

Ethical considerations presented another major challenge. The use of personal data raised concerns regarding privacy and protection. AI algorithms were susceptible to bias, potentially resulting in unfair or discriminatory outcomes. For instance, in recruitment, AI systems could unfairly assess candidates due to historical training data containing discriminatory patterns (Bittman *et al.*, 2024). To address such issues, companies were advised to establish ethical standards for the development and deployment of AI, ensure algorithmic transparency, and conduct regular audits to detect and correct bias. Financial costs represented a substantial barrier, particularly for small and medium-sized enterprises (SMEs). AI implementation required significant investment in technological infrastructure, including server upgrades, expansion of data storage, enhancement of computing power, and integration of new software solutions into existing business systems. Large corporations likewise faced financial constraints, as full-scale AI integration often demanded modernisation of data centres, acquisition of high-performance GPUs for deep learning, and the deployment of specialised platforms for big data analytics (Business strategies using…, 2024).

To alleviate financial burdens, companies could utilise cloud-based AI services that provided access to advanced tools without requiring investment in expensive hardware or software licences. Platforms such as Google Cloud AI, Microsoft Azure AI, and Amazon Web Services (AWS) AI enabled organisations to process vast data volumes, leverage cutting-edge machine learning models, and automate business processes on a pay-as-you-go basis. This reduced initial infrastructure costs and allowed flexibility in scaling according to operational needs. For example, Netflix used AWS AI to analyse user data and improve its recommendation system without building proprietary infrastructure to handle massive datasets (Otsokolich, 2024). In addition to cloud services, enterprises could reduce expenses by using open-source machine learning libraries and frameworks, such as TensorFlow, PyTorch, and Scikit-learn (Technologies to optimise…, 2024). These tools allowed AI implementation without incurring development costs for custom algorithms. Another increasingly popular strategy involved outsourcing AI solutions by engaging external providers specialising in AI development and integration. This helped reduce the costs of maintaining in-house expert teams. For instance, Revolut collaborated with outsourcing companies to deploy AI algorithms for financial monitoring and fraud detection (Technologies to optimise…, 2024). Thus, although AI implementation might incur high costs, businesses could mitigate expenses through cloud computing, open-source platforms, and outsourced solutions, making advanced technologies more accessible – even to SMEs.

Another critical challenge concerned the shortage of qualified professionals in the field of artificial intelligence (AI). The development, deployment, and maintenance of such systems required advanced expertise in programming, data analysis, and technology management. Given the high demand for specialists in this domain, intense competition for skilled personnel had emerged. According to McKinsey, only 16% of companies reported that their workforce possessed the skills necessary to work with AI (The state of AI..., 2023). Many enterprises faced difficulties in retaining skilled staff or were compelled to engage expensive external consultants. To address this issue, it was essential to invest in employee training and reskilling, while also fostering cooperation with academic institutions to support the development of relevant expertise. Collaboration between industry and universities in AI education had become a widespread practice in many countries and had demonstrated positive outcomes. For example, Siemens partnered with the University of Lincoln (UK) and Transilvania University of Brașov (Romania) to develop educational programmes tailored to industry needs (Maksymchuk, 2023). This collaboration contributed to the preparation of specialists equipped with practical competencies, thereby enhancing their competitiveness in the labour market.

Similar initiatives had also been implemented in Ukraine. The Lviv IT Cluster, in collaboration with representatives of technology companies, modernised 19 undergraduate educational programmes across four universities in Lviv (Investing in knowledge..., 2024). From their first year, students worked in teams and developed independent projects, thereby cultivating entrepreneurial skills. At Taras Shevchenko National University of Kyiv, the establishment of a specialised school for AI training had been planned in partnership with American institutions (Ukraine will train..., 2024). Additionally, Ukraine's Ministry of Digital Transformation created a catalogue of educational programmes for prospective university students, offering information on training in AI-related fields such as data analysis, machine learning, and other specialisations (We created a catalogue..., 2020). The effectiveness of such programmes depended on the depth of business involvement in the educational process, the relevance of curricula, and the extent to which students could gain practical experience. Collaboration between universities and AI companies in workforce training had become a decisive factor in the development of AI education in Ukraine (The AI ecosystem..., 2024). These initiatives reflected a positive influence on the preparation of specialists capable of meeting the contemporary challenges of the AI industry.

Regulatory constraints also played a significant role in *AI* adoption. Governments worldwide had been developing laws and regulations to govern *AI* use and data protection. The *European Union's General Data Protection Regulation (GDPR)* imposed strict requirements for handling personal information. Organisations failing to comply with these regulations faced substantial penalties. The *GDPR* stipulated that personal data must be processed lawfully, fairly, and transparently in relation to the individual. Data collection had to serve specific, legitimate purposes, and subsequent processing could not contradict those purposes. A key principle of data minimisation required companies to collect only the information strictly necessary for designated tasks. Data had to be accurate and, where necessary, regularly updated, and retained only for as long as needed to fulfil declared processing goals. Integrity and confidentiality also had to be safeguarded, ensuring protection from unauthorised or unlawful processing, accidental loss, destruction, or damage (Regulation (EU) 2016/679 of the European Parliament and of the Council, 2016).

To ensure compliance with regulatory frameworks, organisations were advised to establish specialised departments responsible for monitoring legal adherence or to engage external experts (Deloitte, 2024). Another significant concern related to the reliability and security of AI systems. Cyberattacks targeting AI algorithms had the potential to compromise data or disrupt system operations. In 2023, a substantial increase in cyberattacks aimed at AI-driven systems was recorded, generating additional risks for enterprises (Bittman *et al.*, 2024). To mitigate such threats, businesses needed to implement multi-layered security architectures that included data encryption, regular system audits, and the promotion of cyber hygiene practices among employees. Despite these challenges, organisations that succeeded in integrating AI technologies could derive considerable benefits. Automating routine operations enabled the reallocation of resources toward strategically important tasks, while AI's analytical capabilities supported precise forecasting and more informed decision-making. To achieve these outcomes, companies needed to revise their strategic approaches, invest in innovation, and apply best practices for AI adoption.

The implementation of artificial intelligence in entrepreneurship created substantial opportunities for enhancing business performance, optimising workflows, and generating innovation. However, to maximise results, companies were required to formulate clear AI integration strategies that accounted for both technological and organisational aspects. Key recommendations for AI adoption and utilisation included the following: investment in data quality, training and reskilling, change management strategies, and continuous monitoring and improvement (Yasinska, 2021).

Investment in data quality. Data quality constituted the foundation of any effective AI system. To ensure high algorithmic performance, companies needed to invest in data collection, cleansing, and standardisation infrastructure. The use of modern data management technologies – including big data platforms – helped prevent losses. Integrating data from diverse sources was critical to constructing a comprehensive view of business processes.

Training and reskilling. The effective use of AI required personnel to possess the necessary competencies. According to McKinsey, only 16% of enterprises reported their staff being adequately prepared for AI-related tasks. It was recommended to develop training programmes

covering machine learning fundamentals, data analysis, and technology governance. Collaboration with universities and training centres enabled the preparation of specialists capable of embedding AI into business processes. A culture of lifelong learning was essential to support employee adaptation to rapidly evolving technologies (The state of AI..., 2023).

Change management strategies. AI implementation frequently involved substantial modifications to business processes and organisational structure. A robust change management strategy was essential for successful integration, encompassing employee engagement, training, and adaptation to technological transformation. Active leadership played a crucial role by initiating change, articulating strategic vision, and providing continuous support throughout the innovation journey. Transparent communication – particularly regarding the objectives and benefits of AI deployment – reduced resistance and improved employee engagement. Training initiatives such as workshops, online courses, or specialised reskilling programmes were critical for workforce adaptation. A notable example was Amazon's large-scale "Upskilling 2025" programme (Upskilling 2025 Annual Report, 2021). It was also advisable to begin with pilot projects to evaluate AI's effectiveness and scalability before full-scale deployment. Furthermore, involving employees in the transformation process, fostering a culture of innovation, and designating "digital ambassadors" significantly increased the likelihood of successful AI integration (Sizing the prize..., n.d.).

Monitoring and continuous improvement. AI implementation did not conclude at the deployment stage. Long-term success required continuous performance assessment, system adjustments, and adaptation to changing business environments. This included regular monitoring of key performance indicators (KPIs) and user feedback collection. Amazon utilised AI to analyse purchasing behaviour and forecast market trends, thereby improving inventory management and reducing stockouts. By employing machine learning algorithms, the company minimised supply chain disruptions and stock imbalances. The adoption of new technologies in logistics and fulfilment aimed to enhance customer interaction, reduce order-processing costs, and optimise freight flow. AI was increasingly applied in conveyor-based technologies across numerous industries, including logistics. Real-time analytics enabled optimal resource allocation, shorter delivery times, and reduced fuel consumption. A prominent example was DHL, which implemented AI solutions for demand forecasting, route optimisation, and logistics process monitoring. These applications significantly improved operational efficiency.

According to the research presented by N. Falovych & O. Dubchak (2023), the automation of routine logistics processes through AI enabled cost reduction, improved cargo tracking, and enhanced customer satisfaction. Additionally, the study conducted within the framework of digital transformation in logistics companies highlighted that the growth of trade volumes and the need for faster delivery stimulated the adoption of advanced technologies, including AI, for supply chain optimisation and cost reduction (Dyma *et al.*, 2023). The use of machine learning algorithms allowed companies to anticipate delays and adjust routes based on weather and road conditions, contributing to resource savings and improved logistics service quality.

Technological development facilitated the active adoption of new management systems, particularly AI and the Internet of Things (IoT), which supported process automation, operational efficiency, and real-time data processing. AI in business encompassed operations optimisation, data-driven decision-making, logistics automation, and customer interaction personalisation. Meanwhile, IoT technology enabled interaction among smart devices, increasing productivity and automating control over production systems. These technologies delivered notable advantages: AI enabled faster large-scale data analysis, risk forecasting, and decision-making enhancement, while IoT enabled remote equipment control, automatic system monitoring, and energy consumption optimisation. In manufacturing, IoT sensors helped monitor equipment condition, prevent malfunctions, and minimise operational costs. However, alongside numerous benefits, the integration of these technologies introduced new cybersecurity challenges. Remote access and the proliferation of connected devices increased vulnerability to cyberattacks, potentially leading to data breaches, compromised operations, and financial losses. Key threats included supply chain attacks, unauthorised access to IoT devices, and the use of AI to automate cyberattacks. Balancing innovation adoption with security had become a critical concern amid digital transformation. To mitigate risks, companies were encouraged to implement cybersecurity strategies incorporating multi-factor authentication, regular system updates, data access control, and the use of AI algorithms for real-time threat detection.

Under globalisation and international integration, adapting to new standards had become vital for organisations. One of the most prominent regulatory frameworks was Regulation (EU) 2016/679 of the European Parliament and of the Council (2016), adopted in European countries. These data protection provisions required companies to review and improve their internal data handling policies. The use of AI-based technologies could complicate data processing and storage compliance. Large corporations such as General Electric and Siemens emphasised strengthening digital system security to reduce AI-related risks.

AI exerted substantial influence on production processes, particularly in their optimisation. Its implementation contributed to higher labour productivity, improved product quality, and cost reduction. Technologies such as AI-driven automation modified production cycles through predictive analytics and decentralised blockchain-based structures, boosting profitability and reducing employee workload. Such algorithmic tools enhanced management, logistics, marketing strategies, and financial processes. An example of AI-driven automation in manufacturing was

the use of predictive maintenance, where AI algorithms analysed equipment data to forecast potential failures. This approach enabled enterprises to schedule maintenance as needed, preventing unplanned downtime and extending equipment lifespan (The impact of artificial intelligence..., n.d.). Festo, for instance, used AI to analyse machine and system data in real time, facilitating fault detection and production process optimisation (Blume, 2024). Another example included personalised marketing in retail, where AI systems analysed customer data to deliver tailored recommendations and campaigns, improving engagement and increasing sales (The impact of artificial intelligence..., n.d.). Despite progress in AI, several challenges persisted. High implementation costs, the demand for skilled professionals, and data security concerns continued to hinder adoption. Widespread AI and automation altered work environments, prompting ethical and social considerations. Besides potential job displacement across sectors, AI-driven business transformation introduced additional negative effects. Chief among them was the widening digital divide, where AI-empowered enterprises gained competitive advantages while under-resourced firms struggled to keep pace. This disparity risked market concentration among large corporations and the marginalisation of SMEs.

Automation also raised serious concerns about workforce reskilling. New skill requirements related to AI operations, big data, and cybersecurity created obstacles for employees in traditional roles. Career changes proved difficult, and those who remained often experienced increased psychological pressure due to higher responsibility, rapid adaptation demands, and job security fears. While automation improved efficiency, it did not always replicate human sensitivity or flexibility. Consequently, sectors such as healthcare, education, and customer service risked losing the personal touch essential to service quality. Another critical risk involved ethical bias embedded in AI algorithms. Such bias could influence decision-making in recruitment, financial services, or law enforcement. Lack of transparency in AI-driven decisions posed risks of discrimination and human rights violations. Successful AI integration in business required balancing productivity gains with social responsibility. Companies were advised to implement reskilling programmes, establish ethical AI guidelines, and create employee support mechanisms during organisational change. Over the next 10-20 years, AI adoption in manufacturing was expected to increase global productivity significantly. To harness the full potential of innovation, organisations were urged to develop sustainable digital transformation strategies addressing both internal process optimisation and external social impact.

Leading scholars and practitioners had been actively investigating how artificial intelligence transformed business processes within large enterprises. Their findings generally confirmed that AI contributed to the automation of routine operations, improved efficiency, and accelerated decision-making. D. Oriekhov (2024) emphasised that AI implementation had become an integral element of modern enterprise management, offering sustainable competitive advantages as economies underwent digitalisation. Other researchers reached similar conclusions. Summarising findings across industries, D. Jain & A. Jain (2023) demonstrated the extensive application of AI for automation, analytics, and service personalisation, reshaping business models and enhancing competitiveness. Based on an entrepreneurial survey, V. Petrenko (2024) observed near-unanimous agreement on the positive impact of AI on productivity and innovation. These approaches positioned AI as a driver of digital transformation: from finance (fraud monitoring, algorithmic trading) to marketing and customer service (recommendation engines, chatbots), enterprises adopted intelligent algorithms to boost business process efficiency and agility. Researchers noted that the full realisation of AI's potential depended on resolving accompanying ethical, staffing, and regulatory issues.

The present study's findings aligned with previous global research while contributing new dimensions. It was established that AI implementation significantly enhanced business process efficiency at large enterprises by automating operations, personalising customer engagement, and improving market trend forecasting. These results corroborated international data. According to Deloitte (2024), over 60% of banks were already employing AI algorithms to analyse large datasets, improving decision accuracy in credit scoring and fraud detection. Financial sector case studies confirmed these outcomes: companies adopting machine learning observed fraud reduction and faster document processing, consistent with experiences at JPMorgan Chase and Japanese banks Mizuho and SMFG. In retail, improvements in recommendation accuracy – reflected in higher conversion rates – corresponded with Amazon's reports of a 30% increase in sales from recommended products due to deep learning algorithms. AI also positively influenced employee productivity. In an experimental scenario involving generative AI coding assistants, junior developers completed 25% more tasks. This closely matched findings from S. Peng *et al*. (2023), whose large-scale study showed that GitHub Copilot increased developer task completion rates by around 26% while also improving code quality. Such consistency validated the current study and highlighted the global nature of these trends.

Nonetheless, differences remained. Previous studies tended to focus on specific industries or metrics (e.g., finance or technical indicators), whereas this study covered enterprises of various sizes and sectors, employing an interdisciplinary methodology (systems analysis, case studies, statistics). This approach revealed both universal AI impacts and sector-specific effects. Notably, the study examined early generative AI use in marketing and product development – areas only recently addressed in the literature. While many sources presented conceptual overviews or isolated experiments, this analysis was based on real corporate initiatives from 2023-2024. Despite the outlined benefits, both literature and the study acknowledged critical challenges associated with widespread AI adoption.

Foremost were ethical and legal concerns. AI algorithms could inherit bias from training data, leading to discrimination against certain customer or employee groups. Documented cases showed biased hiring decisions made by AI-based systems due to skewed historical datasets. The current analysis confirmed this issue and emphasised the need for bias monitoring. Another ethical concern involved data privacy. As AI systems processed vast volumes of personal information, data breaches or misuse posed risks to user rights. These findings aligned with international expert warnings that algorithmic transparency and privacy protection must be foundational to AI deployment. Additional attention was drawn to unresolved intellectual property issues concerning AI-generated content, and to the risk of over-reliance on automated decision-making. V. Petrenko (2024) reported that entrepreneurs feared a decline in uniqueness and creativity due to AI-driven standardisation, which could strip businesses of their individuality. Staffing challenges were also significant. AI transformed job roles by automating functions, intensifying labour market pressures. Workers feared displacement, and companies faced the need to reskill their workforce. A gap remained in professionals capable of bridging management expertise with AI understanding – an issue also identified by D. Oriekhov (2024), who called for cross-functional teams combining business process and AI knowledge.

According to A. Chakraborty *et al*. (2024), 82% of companies in early AI adoption stages lacked talent development strategies and suitable generative AI training programmes, confirming the global relevance of this issue. D. Jain & A. Jain (2023) drew similar conclusions, stressing the need for human-AI collaboration cultures and workforce preparation. Regulatory and financial challenges formed another problem cluster. Regulatory frameworks often lagged behind AI's rapid evolution, generating legal uncertainty around accountability for AI-driven decisions and algorithm certification. Businesses faced a dilemma: how to harness AI innovatively while ensuring compliance with safety and ethics standards. Financial constraints included high initial investments and unclear short-term returns. While AI was expected to reduce costs and increase profits, empirical studies offered no definitive evidence of sustained financial impact. For instance, McKinsey (The state of AI…, 2023) reported that although 78% of companies used AI in at least one function, only 16% had fully modernised their processes based on AI, and only a small subset reported significant financial gains. Most remained in experimental phases, struggling with solution scalability due to unprepared data and infrastructure. Thus, critical analysis confirmed that for AI to become a true catalyst of business transformation, companies must overcome substantial ethical, staffing, regulatory, and economic barriers.

Based on the study's findings, several recommendations were formulated for large enterprises seeking to effectively integrate AI into their business processes. These included strategic implementation planning, workforce development, ethical risk mitigation, technological infrastructure preparation, pilot project deployment, and executive support. Strategic AI implementation planning needed to align with the company's overarching business strategy. Within this strategy, it was important to identify priority areas for AI application – such as manufacturing, marketing, and finance – along with clearly defined expected outcomes. Case studies from successful firms indicated that without a systematic approach, AI initiatives remained fragmented and lacked synergy. Strategic planning also required consideration of rapid technological evolution and the need for flexibility in updating implementation roadmaps. Developing human capital was critical to AI adoption. This involved investing in staff training and reskilling programmes focused on data literacy and machine learning. Structured training initiatives for both managers and specialists addressed the knowledge gaps identified in the study. In addition, companies were encouraged to foster a culture of effective human–technology collaboration, in which employees understood both the capabilities and limitations of AI. To bridge the talent gap, the involvement of external experts and academic partnerships was recommended.

Ethical and transparent AI deployment represented another vital success factor. From the outset, companies were advised to establish ethical standards and governance mechanisms. This entailed internal policies for responsible data usage, privacy protection, algorithmic transparency, and bias mitigation. Findings indicated that companies with dedicated AI ethics committees faced less resistance from employees and customers. Regular algorithm audits for bias and accuracy, especially for generative AI, helped prevent major errors and reputational damage. According to McKinsey (The state of AI…, 2023), 27% of firms reported verifying all AI-generated content. Effective AI integration also required building appropriate technological infrastructure and ensuring data quality. This meant investing in high-quality datasets, computational resources, centralised data storage, regular data cleansing and updates, and standardised data governance. As noted by A. Chakraborty *et al*. (2024), developing a robust digital core and efficient data management were prerequisites for scalable AI projects. The present study confirmed that companies with advanced data infrastructure adopted new AI tools more rapidly and demonstrated superior financial performance.

AI adoption was recommended to begin with pilot projects in the most problematic or promising business areas. These initial implementations enabled performance testing under real conditions while minimising risk. According to the study, firms that piloted limited AI use cases – such as chatbots within a single support team or demand forecasting for selected product categories – successfully scaled these solutions company-wide after achieving positive outcomes. During the scaling phase, it was essential to regularly assess AI's economic impact, including cost changes, process cycle duration, and customer satisfaction. A key success factor for AI-driven initiatives was shared responsibility and active support from senior leadership.

Executives were expected to engage directly in the digital transformation process and assume accountability for outcomes. Close collaboration between IT specialists and business users during AI deployment and development facilitated alignment. Creating cross-functional working groups to define algorithm requirements, assess business impact, and adapt organisational structures ensured a comprehensive approach to transformation. This allowed AI to evolve from an external tool into an integral component of the enterprise's management ecosystem.

Implementing these recommendations would enable large enterprises to fully harness AI's potential for business process transformation. Global practices confirmed this: companies that approached AI implementation holistically – combining technology with process reengineering, staff training, and ethical oversight – achieved greater revenue and productivity growth than competitors. In conclusion, integrating previous research insights with the study's empirical findings, it was evident that successful AI-driven digital transformation required simultaneous focus on technology, people, and processes. Only through this triad could AI innovation produce sustainable, positive organisational change.

Conclusions

The implementation of artificial intelligence emerged as a key factor in modern business transformation, offering enterprises competitive advantages, innovation-driven growth, and operational efficiency. The analysis of AI's impact on business processes demonstrated the potential of these technologies to optimise operations, automate routine tasks, enhance analytics, and support personalised customer interactions. The research objective – a comprehensive analysis of AI's influence on the transformation of business processes across enterprises of various scales – was successfully achieved. The findings confirmed that AI implementation contributed to improved operational efficiency, streamlined management processes, enhanced customer experience personalisation, and more accurate market trend forecasting. Moreover, process automation enabled cost reductions and accelerated decision-making, thereby strengthening firms' competitiveness. It was established that in the financial sector, machine learning algorithms reduced fraud rates by enabling more precise transaction and risk analysis. In retail, AI improved logistics efficiency and facilitated the creation of personalised marketing strategies. In manufacturing, intelligent systems supported predictive maintenance, minimising equipment downtime and enhancing supply chain performance.

The study further confirmed the widespread adoption of generative AI in marketing, design, content management, and automated decision-making. Generative algorithms simplified the creation of text, images, and video content, reducing creative task costs and accelerating time-to-market for new products. Several implementation challenges were identified, including insufficient data quality, a shortage of qualified personnel, high integration costs, ethical concerns, and regulatory constraints. Addressing these challenges required a holistic approach involving investment in data quality, development of ethical standards, staff training, and the deployment of pilot projects to assess technological effectiveness. Enterprises were advised to adapt their business models with a focus on innovation, digitalisation, and AI integration across core functions. The execution of these recommendations was expected to enhance business performance, reduce costs, and ensure long-term success in a dynamic digital environment. AI functioned not only as an optimisation tool but also as a catalyst for strategic transformation, enabling enterprises to adapt to contemporary challenges and unlock new development opportunities. Future research avenues included the assessment of long-term socio-economic implications of widespread AI adoption, development of effective workforce training methodologies for interaction with intelligent systems, and evaluation of the impact of emerging regulatory frameworks on innovative business model evolution. Further attention was recommended for the integration of AI into corporate governance systems and the evaluation of its influence on strategic decision-making across enterprises of varying sizes.

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Conflict of Interest

None.

References

[1] Abbasi, M., Nishat, R.I., Bond, C., Graham-Knight, J.B., Lasserre, P., Lucet, Y., & Najjaran, H. (2024). A review of AI and machine learning contribution in predictive business process management (process enhancement and process improvement approaches). *ArXivi*. doi: 10.48550/arXiv.2407.11043.

[2] Artificial intelligence in the Ukrainian banking sector: An opportunity or a necessity? (2024). Retrieved from https://forbes.ua/innovations/shtuchniy-intelekt-v-ukrainskomu-bankivskomu-sektori-mozhlivist-chi-neobkhidnist-30042024-20636.

[3] Beheshti, A., Yang, J., Sheng, Q.Z., Benatallah, B., Casati, F., Dustdar, S., Motahari Nezhad, H.R., Zhang, X., & Xue, S. (2023). ProcessGPT: Transforming business process management with generative artificial intelligence. In *2023 IEEE International conference on web services*. New York: IEEE.

[4] Bhavsar, K., Shah, V., & Gopalan, S. (2019). Business process reengineering: A scope of automation in software project management using artificial intelligence. *International Journal of Engineering and Advanced Technology (IJEAT)*, 9(2), 3589-3595. doi: 10.35940/ijeat.B2640.129219.

[5] Bittman, T., Dukes, M., & Troy, A. (2024). 2025 *Strategic roadmap for edge computing*. Retrieved from https://www.gartner.com/en/documents/6352379.
[6] Blume, M. (2024). *AI in industry: What companies should pay attention to*. Retrieved from https://www.festo.com/ua/uk/e/journal/innovation/shi-v-promislovosti-na-shcho-kompaniiam-varto-zviernuti-uvaghu-id_2009683/.
[7] Business strategies using artificial intelligence: Gain a competitive advantage in the digital market. (2024). Retrieved from https://www.agiliway.com/uk-ua/stratehiyi-biznesu-z-vykorystannyam-shtuchnoho-intelektu-zdobudte-konkurentnu-perevahu-na-tsyfrovomu-rynku.
[8] Chakraborty, A., Tayob, Y., & Rao, B. (2024). *How reinvention-ready companies are driving growth and relevance with gen AI*. Retrieved from https://www.accenture.com/content/dam/accenture/final/accenture-com/document-3/Reinventing_Enterprise_Operations.pdf.
[9] Chernysheva, O.O., Domashenko, S.V., & Domashenko, D.H. (2024). The influence of artificial intelligence on business processes with the purpose of optimizing and improving the efficiency of the organization. *Scientific notes of Taurida National V.I. Vernadsky University. Series: Technical Sciences*, 35(74), 196-203. doi: 10.32782/2663-5941/2024.2/27.
[10] Deloitte. (2024). *The State of generative AI in the enterprise*. Retrieved from https://www2.deloitte.com/us/en/pages/consulting/articles/state-of-generative-ai-in-enterprise.html.
[11] Dyma, O., Martynenko, M., & Kryveshchenko, V. (2024). Digital transformation of logistics: New opportunities and tools. *Economics. Management. Business*, 4, 58-65. doi: 10.31673/2415-8089.2024.044853.
[12] Encova Insurance: Customer-focused innovation at its best. (n.d.). Retrieved from https://www.uipath.com/resources/automation-case-studies/encova-insurance-scales-automation.
[13] Falovych, N., & Dubchak, O. (2023). Implementation of artificial intelligence in logistics: The future of the logistics industry. In *Materials of the II Ukrainian scientific and practical internet conference "Marketing technologies of enterprises in the modern scientific and technical environment"* (pp. 143-144). Ternopil: West Ukrainian National University.
[14] Global Bilgi. (n.d.). *Robotic process automation (RPA): Revolutionizing efficiency for businesses.* Retrieved from https://blog.globalbilgi.com.ua/en/robotic-process-automation-rpa-revolutionizing-efficiency/.
[15] Habeeb, H.A., Abd Wahab, D., Azman, A.H., & Alkahari, M.R. (2023). Design optimization method based on artificial intelligence (hybrid method) for repair and restoration using additive manufacturing technology. *Metals*, 13(3), article number 490. doi: 10.3390/met13030490.
[16] Holei, Yu., & Drik, I. (2023). Analysis of the use of artificial intelligence in business process management systems: Advantages and disadvantages. In *The international scientific and practical conference "Challenges and issues of modern science"*. Dnipro: Oles Honchar Dnipro National University.
[17] How much does a business lose due to a data breach? – IBM report 2021. (2021) Retrieved from https://denovo.ua/blog/vitok-danyh-v-2021-ibm.
[18] Investing in knowledge: How cooperation between education and business shapes the leaders of the future. (2024). Retrieved from https://itcluster.lviv.ua/investyczyi-v-znannya-yak-spivpraczya-osvity-ta-biznesu-formuye-lideriv-majbutnogo.
[19] Jain, D., & Jain, A. (2023). Impact of artificial intelligence on business transformations. *International Journal of Creative Research Thoughts (IJCRT)*, 11(11), 169-173.
[20] Makhova, H., & Vostriakova, V. (2022). Artificial intelligence in entrepreneurship: Opportunities and prospects of using. *Economy and Entrepreneurship*, 49, 75-89. doi: 10.33111/EE.2022.49.MakhovaH_VostriakovaV.
[21] Maksymchuk, L. (2023). *Business is going to universities: how companies grow future leaders from the ranks of students*. Retrieved from https://focus.ua/uk/economics/611616-biznes-yde-v-universiteti-yak-kompaniji-zi-studentskih-lav-viroshchuyut-maybutnih-lideriv.
[22] Oriekhov, D. (2024). Usage of artificial intelligence in management of modern enterprise. *Economy and Society*, 64. doi: 10.32782/2524-0072/2024-64-143.
[23] Otsokolich, V. (2024). *Implementation of artificial intelligence solutions in companies: Key advantages and risks*. Retrieved from https://biz.ligazakon.net/analitycs/232371_vprovadzhennya-rshen-shtuchnogo-ntelektu-v-kompan-osnovn-perevagi-ta-riziki.
[24] Peng, S., Kalliamvakou, E., Cihon, P., & Demirer, M. (2023). The impact of AI on developer productivity: Evidence from GitHub Copilot. *ApXiv*. doi: 10.48550/arXiv.2302.06590.
[25] Petrenko, V. (2024). Impact of artificial intelligence on future entrepreneurship: Survey results and trends analysis. *Review of Transport Economics and Management*, 11(27), 131-139. doi: 10.15802/rtem2024/304822.
[26] Predictive maintenance: Maximising equipment efficiency through condition monitoring. (n.d.). Retrieved from https://www.danfoss.com/uk-ua/about-danfoss/our-businesses/drives/knowledge-center/condition-monitoring-with-intelligent-drives/predictive-maintenance/.
[27] Recruitment of the future: How global companies are using AI for hiring. (2024). Retrieved from https://news.finance.ua/ua/rekrutynh-maybutn-oho-yak-svitovi-kompanii-vykorystovuyut-shi-dlya-naymu.

[28] Regulation (EU) 2016/679 of the European Parliament and of the Council "On the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of Such Data, and Repealing Directive 95/46/EC (General Data Protection Regulation)". (2016, April). Retrieved from https://gdpr-info.eu/.
[29] Sizing the prize. PwC's global artificial intelligence study: Exploiting the AI revolution. (n.d.). Retrieved from https://www.pwc.com/gx/en/issues/artificial-intelligence/publications/artificial-intelligence-study.html.
[30] Technologies to optimise costs and resources. (2024). Retrieved from https://investstart.com.ua/sposobi-optimizatsii-vitrat-za-dopomogoyu-texnologij.
[31] The AI ecosystem of Ukraine: Talent, companies, and education. (2024). Retrieved from https://aihouse.org.ua/research/ai-ecosystem-of-ukraine-talent-companies-education.
[32] The impact of artificial intelligence in automation: Revolutionising industries. (n.d.). Retrieved from https://julienflorkin.com/uk/бізнес/автоматизація/штучний-інтелект-в-автоматизації.
[33] The state of AI in 2023: Generative AI's breakout year. (2023). Retrieved from https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year.
[34] Top 10 modern methods of recruitment. (2024). Retrieved from https://hurma.work/blog/top-metodiv-suchasnogo-rekrutingu.
[35] Ukraine will train specialists in artificial intelligence. (2024). Retrieved from https://www.ukrinform.ua/rubric-society/3858904-v-ukraini-gotuvatimut-fahivciv-u-galuzi-stucnogo-intelektu.html.
[36] Upskilling 2025 Annual Report. (2021). Retrieved from https://assets.aboutamazon.com/28/48/6b990cf448b5b4064a54c63cb6c8/amazon-upskilling-report.pdf.
[37] Verbivska, L. (2023). Application of artificial intelligence tools in managing enterprise competitiveness. *Problems of Modern Transformations. Series: Economics and Management*, 10, 85-90. doi: 10.54929/2786-5738-2023-10-04-06.
[38] We created a catalogue of Ukrainian educational programmes in the field of artificial intelligence. (2020). Retrieved from https://thedigital.gov.ua/news/mintsifra-stvorila-katalog-iz-ukrainskimi-osvitnimi-programami-v-sferi-shtuchnogo-intelektu.
[39] Yasinska, A. (2021). Accounting procedures digital transformation for business processes improvement. *Economics, Entrepreneurship, Management*, 8(2), 44-50. doi: 10.23939/eem2021.02.044.
[40] Yurasov, S. (2024). *How artificial intelligence is changing the way banks operate. Analysing this topic on the examples of Sense Bank and leading international institutions*. Retrieved from https://dev.ua/en/news/sense-1731912938.
[41] Zavrazhnyi, K. (2023). The role of virtual patients and simulators in simulation training and clinical medical education of Ukraine. *Academic Visions*, 26. doi: 10.5281/zenodo.10257188.

Вплив штучного інтелекту на трансформацію бізнес-процесів підприємств

Катерина Андрющенко
Доктор економічних наук, професор
Київський національний економічний університет імені Вадима Гетьмана
03057, просп. Берестейський, 54/1, м. Київ, Україна
https://orcid.org/0000-0002-6274-5310

Святослав Марчук
Аспірант
Київський національний економічний університет імені Вадима Гетьмана
03057, просп. Берестейський, 54/1, м. Київ, Україна
https://orcid.org/0009-0004-4217-1075

Анотація. Швидкий розвиток штучного інтелекту кардинально трансформував бізнес-середовище, оптимізуючи процеси управління, підвищуючи ефективність та створюючи нові виклики для підприємств. Це обумовлює актуальність аналізу його впливу на трансформацію бізнес-процесів. Метою дослідження було проаналізувати вплив штучного інтелекту на трансформацію бізнес-процесів підприємств різного масштабу, визначити основні напрями його застосування та оцінити потенційні перспективи розвитку. Дослідження базувалося на використанні системного аналізу, порівняльного аналізу, кейс-методу та аналізу статистичних даних. Було опрацьовано наукові публікації, корпоративні звіти, матеріали аналітичних компаній та практичні приклади впровадження штучного інтелекту у провідних компаніях. Результати дослідження показали, що впровадження штучного інтелекту значно підвищило ефективність бізнес-процесів великих підприємств через автоматизацію операцій, персоналізацію взаємодії з клієнтами та поліпшене прогнозування ринкових тенденцій. У фінансовому секторі алгоритми машинного навчання дозволили знизити рівень шахрайства та суттєво прискорити процес обробки документів, що узгоджується з міжнародним досвідом провідних банків, таких як JPMorgan Chase, Mizuho і SMFG. У сфері роздрібної торгівлі було зафіксовано покращення точності рекомендаційних систем, аналогічно до результатів глобальних компаній, таких як Amazon і Netflix, де персоналізація забезпечила зростання конверсійних показників. Виробничі підприємства повідомили про оптимізацію управління логістикою та скорочення операційних витрат завдяки впровадженню ШІ. Крім того, підприємства активно досліджували можливості генеративного штучного інтелекту у маркетингу, розробці продуктів та підвищенні продуктивності працівників, отримавши результати, які узгоджуються з міжнародними практиками, такими як впровадження інструменту GitHub Copilot, що підвищив швидкість і якість роботи розробників програмного забезпечення. Практична цінність дослідження полягає у можливості використання його результатів керівниками компаній, аналітиками та бізнес-консультантами для вдосконалення стратегій цифрової трансформації та підвищення конкурентоспроможності підприємств

Ключові слова: цифрова трансформація; машинне навчання; бізнес-аналітика; автоматизація процесів; корпоративне управління; клієнтський досвід; етичні виклики

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Current trends and practices of HR management in the conditions of digitalisation of the economy

Natalia Karpenko*

PhD in Public Administration, Associate Professor
National University "Zaporizhzhia Polytechnic"
69063, 64 Zhukovsky Str., Zaporizhzhia, Ukraine
https://orcid.org/0000-0002-9301-3649

Oleksandr Safronkin

Postgraduate Student
National University "Zaporizhzhia Polytechnic"
69063, 64 Zhukovsky Str., Zaporizhzhia, Ukraine
https://orcid.org/0009-0005-4117-8563

Oleksandr Karpenko

Postgraduate Student
National University "Zaporizhzhia Polytechnic"
69063, 64 Zhukovsky Str., Zaporizhzhia, Ukraine
https://orcid.org/0009-0004-3701-3769

Oleksandr Chernov

Postgraduate Student
National University "Zaporizhzhia Polytechnic"
69063, 64 Zhukovsky Str., Zaporizhzhia, Ukraine
https://orcid.org/0009-0004-3753-0491

Abstract. The study of HR management trends and practices in the context of economic digitalisation is crucial for effective adaptive personnel management, which will enhance organisations' competitiveness in the future. This article aimed to explore the trends and practices of HR management in enterprises under the conditions of digitalisation of the economy. The study employed methods of analysis and synthesis (analysing HR trends and practices, synthesising data on the impact of digitalisation on personnel management), systematisation and generalisation (systematising key HR management trends), abstraction (identifying general principles and approaches in personnel management), and formal logic (structuring the study and substantiating logical conclusions). The research examined technological advancements and social development dynamics that influence HR trends and transform human resource management. The growing role of HR functions was identified, and current HR trends were analysed. The findings demonstrated that organisations, under the influence of these trends, prioritise strategic directions such as hybrid work formats, work-life balance, HR process automation, employee well-being and mental health programmes, and investments in employee training and development. It has been established those digital technologies provide easy access to necessary resources and enable remote work, increasing productivity at both individual and organisational levels. The article highlighted both the positive and negative effects of digitalisation on HR management processes. For the successful integration of digital tools, the importance of meticulous planning was emphasised, considering potential threats and weaknesses to maximise opportunities and minimise risks, as well as recognising the crucial role of leadership in HR digitalisation. The practical significance of the study lies in justifying a comprehensive approach to HR practice implementation, where key factors include leadership, employee support, and readiness for continuous changes in the technological environment

Keywords: HR processes; digital transformation; personnel; talents; human resources; management; organisation

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*Corresponding author

Introduction

The processes of digital transformation are encompassing an increasingly significant part of the global economy, leading to significant changes across all spheres of society. Alongside new opportunities and prospects for social development, challenges are emerging not only in the economy and business, but also in public services, education, healthcare, social relations, careers, cultural shifts, and beyond. Digital transformation is not only limited beyond technological aspects, but also encompasses cultural, organisational, and strategic changes. The transition to a digital economy, dynamism, and the rapid innovative technological implementation presents businesses with complex challenges in seeking new, effective models for managing both operations and personnel. Human resources – their knowledge, skills, talents, experience, and intelligence – are the driving force of the digital economy. The use of digital technologies significantly impacts the entire employee lifecycle within organisations, including recruitment, hiring, onboarding, development, and offboarding. In this context, personnel management is the most dynamic subsystem of an enterprise, and a qualitative rethinking of management methods and technologies significantly impacts overall performance, emphasising the importance of studying the effects of digital economic transformations on this field of management.

The peculiarities of digital transformation, digitalisation of the economy, and digitisation itself are widely disclosed by scientists and practitioners across various economic sectors, as the changes driven by digital phenomena affect all spheres of society. In the study by V.S. Kuibida *et al*. (2019), the pivotal role of digital skills in enhancing the quality of human capital and competitiveness in the labour market was emphasised. The authors highlighted the necessity of integrating digital competencies at all levels of education to train professionals capable of adapting to technological changes. According to scientists, while the development of digital competencies has a positive impact on the labour market, contributing to productivity growth, creating new job opportunities in digital technology-related fields, they also pose significant challenges, such as disparities in digital skills development among the population. To prevent the deepening of social inequality, researchers justify the need for state-level measures to address these issues. In the study by Yu.M. Umantsiv (2023), the impact of digital technologies on transformational processes in the economy under global competition was analysed. It was argued that digitalisation has become a key factor in enhancing the competitiveness of both countries and individual enterprises in the global market. The author noted that the use of digital tools in strategic management enables businesses to adapt more effectively to dynamic market conditions by implementing innovative approaches to business process organisation. According to the scientist, overcoming various risks (cybersecurity, data loss, social challenges arising from unequal access to new technologies, etc.) should be grounded in the need to develop appropriate policies and strategies. These measures would help minimise the risks and ensure sustainable growth in the digital economy.

Researcher A. Vankevich (2019) identified the key trends of labour market transformation under the influence of digitalisation, described the main trends in HR management and substantiated the change in requirements for human resource management services in organisations, as well as the modification of their functions, which will contribute to the effective management of human resources in the new environment. Scientists Z.I. Kobelia & S.I. Todoryuk (2022) concluded that digital tools and digitalisation, in general, are crucial for human resource management. That emphasised the necessity of integrating a digital strategy with both business and HR strategies. The authors also pointed out the importance of developing new skills for HR managers and the need to carefully develop HR strategies that cover all stages of HR processes. According to A. Kolot *et al*. (2022), HR managers must be flexible, adaptive, and continuously update their skills in response to rapid technological and economic changes. This includes adaptability, communication skills, strategic thinking, and the ability to learn quickly. The study provided a comprehensive analysis of essential competencies for HR managers in terms of labour market analysis and workforce strategy adaptation. It proves the importance of developing interdisciplinary skills, particularly digital literacy, change management, critical thinking, and the ability to work in uncertain conditions. Additionally, practical recommendations are provided for developing these competencies in the context of global changes.

In the work of A.M. Ali (2022), the importance of digitalisation in human resource management was emphasised as a necessary step for increasing the efficiency and competitiveness of organisations. The author argued that to maximise the benefits of digitalisation, organisations should focus on managing current challenges, developing integrated management systems, ensuring continuous employee training, and conducting regular evaluations of the effectiveness of implemented solutions. According to the conclusions of U. Murugesan *et al*. (2023), the rapid evolution of HR technologies is becoming increasingly characteristic, involving implementation of innovative platforms for talent management and process automation, which enhance management efficiency. The scientists have also substantiated the need for organisations to adapt to modern technological changes to remain competitive, specifically by: implementing artificial intelligence (AI) and big data analytics in HR processes, focusing on cybersecurity and data protection issues, developing new models for personnel management, adapting management approaches, supporting corporate culture, and creating programmes for continuous employee training and development. etc. Various scientific groups have explored a wide range of parameters in enterprise HR management, particularly the impact of digitalisation on HR practices.

Yet, the adaptation of traditional HR processes to the digital environment remains insufficiently studied and requires further research. Therefore, the article aimed to analyse current trends and approaches in the field of human resource management within enterprises in the context of active economic digitalisation.

Materials and Methods

A comprehensive set of methods was applied in this study to analyse the impact of digitalisation on HR processes. The methods of analysis and synthesis were used to study contemporary HR trends, assess their impact on human resource management, and generalise the data obtained. This allowed to identify the key aspects of digital transformation and explore opportunities for integrating new technologies into the HR sphere. The methods of systematisation and generalisation facilitated the organisation of the study results, enabling the identification of key trends in the development of digital HR management. The analysis of scientific sources has confirmed the effectiveness of digital tools in increasing the competitiveness of organisations. The application of the comparative method made it possible to compare traditional and digital HR approaches, revealing their differences, advantages, and disadvantages. This helped to evaluate the effectiveness of different HR management models and identify the best strategies for implementing digital technologies. The method of abstraction was used to highlight the general principles of digital personnel management that can be applied regardless of the organisation specifics. This enabled the identification of universal approaches to adapting HR processes in the digital era. The formal-logical method was applied to structure the study, build well-founded conclusions, and logically organise the results. This ensured clarity in defining the connections between the digitalisation of HR and the effectiveness of personnel management. The conclusions were based on the analysis method, which allowed for the systematisation of different aspects of digital transformation in HR. Changes in approaches to recruitment, employee adaptation, performance management, and corporate culture in the context of the digital economy were explored. The comprehensive approach to the research allowed for a deeper understanding of the digital transformation of HR processes, as well as an assessment of its impact on modern personnel management strategies, determining the prospects for further development in this area.

The study was conducted through the analysis of scientific sources, statistical data, and applied research in HR management within the context of digital transformation. The study period spanned from 2019 to 2024, taking into account the rapid development of technologies and their impact on personnel management. The sequence of the study was carried out from data collection, primary processing, to analysis and synthesis of the results. An analytical framework was presented, and a SWOT analysis was utilised to assess the implementation of digital technologies in HR and the digitalisation of HR processes. The analysis was based on a conceptual model of HR digital transformation. The research drew on theoretical materials, monographs, and analytical reports that explore various aspects of digital transformation and its impact on HR practices (Bei & Sereda, 2019; Kolot *et al.*, 2022; Murugesan *et al.*, 2023). It also incorporated scientific publications, reports from research organisations, statistical data on the effectiveness of digital technologies in HR processes, and insights from real-world business cases. Secondary data from authoritative information sources and analytical platforms, such as McKinsey & Company (Meet the moment..., n.d.) and Deloitte (Occean *et al.*, 2017; Mahoutchian *et al.*, 2023), were analysed. These resources provided current information on trends in digital transformation and HR management. The main conclusions were based on the results of personnel management effectiveness, employee engagement levels, and satisfaction levels. Existing models for assessing the effectiveness of HR processes and approaches to measuring the impact of digital technologies on personnel management were utilised in the study. These methods helped structure the analysis and draw final conclusions.

Results and Discussion

Digital transformation has changed the economic landscape, opening up new opportunities for development and growth. The emergence of the digital economy is a natural outcome of technological progress. It is not only a revolutionary technological process but also a significant factor influencing socio-economic relations in the new economic reality. It is based on the use of information technologies such as artificial intelligence, blockchain, data analytics, the Internet of Things, and others. It promotes the automation of business processes, ensuring more efficient operations for enterprises and enhancing their competitiveness. As defined by the Ukrainian Institute for the Future (n.d.), the digital economy is a type of economy where the key factors and means of production are digital data (binary, information, etc.) and network transactions, as well as their use as a resource, which significantly increases efficiency, productivity, and value for the products and services produced. The main values in the digital economy are information and knowledge, the primary source and bearer of which is the individual. Thus, the digital economy defines a new role for human resources and human capital, not only in response to the constant changes and trends of various innovations. In such an economy, individuals are not simply executors of assigned tasks, but act as key creative and strategic assets, creators of new ideas, innovations, and value. This requires the development of high-quality human capital based on quality education and skills that allow individuals to adapt to rapid changes in the digital environment.

The interaction between intelligent technologies and workers has undergone significant evolution: from the replacement of people with technologies for automating routine, dangerous, and monotonous tasks to becoming indispensable assistants that expand the capabilities of workers and provide new tools for enhancing

productivity. Technologies do not simply replace or complement; they significantly enhance workers, helping them become better professionals and making teams more effective and harmonious (Mahoutchian *et al.*, 2023). This new synergy thus opens up limitless opportunities for the development of human potential and transformative changes in work processes. Innovative technologies are forcing to rethink approaches to measuring and enhancing efficiency at many levels: individual, team, and organisational. Intelligent devices powered by artificial intelligence generate vast arrays of productivity data, which can significantly increase the impact of employees on their performance. Predictions suggest that by 2025, artificial intelligence and machine learning will increase labour productivity by 37%, opening new horizons for development and innovation (Eager *et al.*, 2020). Throughout 2024, the community is focusing on the impact of generative artificial intelligence on business innovation and organisational transformation. The McKinsey & Company study (Meet the moment…, n.d.) emphasises how AI is becoming a strategic partner for executives, helping them optimise operational processes, enhance competitiveness, and unlock new opportunities. The primary focus is on the need for decisive changes in leadership, the development of unique organisational competencies, and the construction of long-term growth strategies based on AI integration experience.

According to L.V. Shaulska & R.I. Hrynkevych (2022), organisations that actively engage in innovative activities must adapt to dynamic and unbalanced market environment through self-organisation mechanisms. Using a synergistic approach, the authors systematised and synthesised management practices that foster the organic coevolution of an organisation with its external environment. This perspective is compelling, as it highlights how an organisation's internal policies, culture, and management mechanisms play a crucial role in driving development and innovation. An important condition in the digital dynamic era is the ability of an organisation not only to adapt to a rapidly changing market environment, but also to actively shape it using self-organisation mechanisms. This implies the introduction of the latest management practices that enable the organisation to respond effectively to changes and influence its development while maintaining flexibility and competitiveness. In the digitalised economy, HR management must be adaptive and integrated with the organisation's overall strategy for innovative development. This means that HR functions, including talent management, competence development and corporate culture, should be oriented on supporting innovation and the organisation's ability to respond quickly to changes in the market environment. Modern HR trends reflect innovative approaches and strategies in human resource management that enable organisations to achieve their strategic goals. These include developing effective talent management programmes, leveraging artificial intelligence and data analytics for decision-making, fostering flexible work cultures and remote work, and prioritising ethical governance, diversity, inclusion, and social responsibility. Such trends help organisations remain competitive and adaptable in an era of rapid change. Human resource management is continuously evolving, with emerging trends shaping how companies attract, retain, and develop talent (Karpenko & Kosinevska, 2024). The most significant HR trends of 2024 are illustrated in Figure 1.

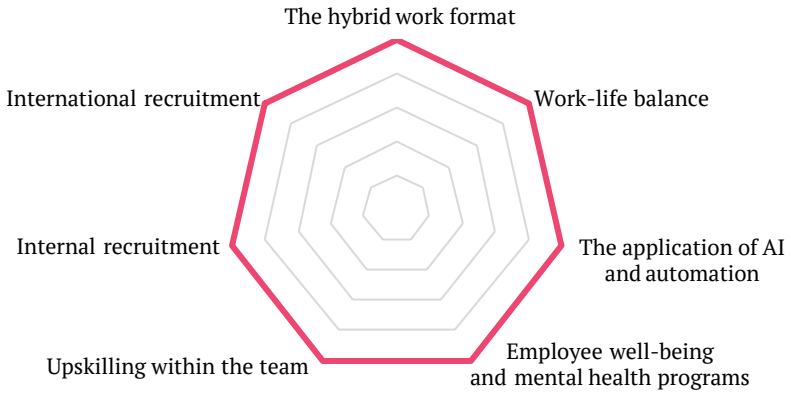

Figure 1. Key HR trends for 2024

Source: created by the authors based on HURMA (2023), N.M. Karpenko & K.O. Kosinevska (2024)

The hybrid work format combines the best of both models: part of the time is spent working in the company's office (for meetings, team discussions on a scheduled or agreed basis, completing specific tasks, etc.), and part is spent working remotely (saving time and resources on commuting, organising a comfortable work process, etc.). Work-life balance, especially in remote work settings, involves the use of concepts such as electronic presentations and a culture of constant accessibility. The application of AI and automation in HR processes (HRM systems, chatbots, virtual assistants, etc.) streamlines operations by accelerating candidate processing, reducing errors, improving employee engagement and retention, monitoring attendance, and providing timely support for complex issues. These technologies also free up time and resources for strategic HR initiatives and workplace enhancements.

The development and application of well-being and mental health programmes for employees goes beyond their job responsibilities and includes their personal and social lives. Enhancing the competitiveness of company employees is achieved by investing in training programmes and adding skilled specialists to established teams. The use of an internal recruitment strategy, which prioritises promoting existing employees to open positions within the company, enables more effective use of existing potential and the retention of talent, as it improves employee morale and job satisfaction, saves significant time and money on recruitment, selection, adaptation, and training, etc. International recruitment is expanding, as there is increasing demand for international experts, who not only contribute to business diversification but also enrich it with new knowledge. However, this requires more time and resources to find suitable candidates.

The digitalisation of HR management goes beyond simply integrating technology, as it involves fostering a digital environment that motivates employees and strengthens the organisation's HR brand. This transformation significantly enhances HR technologies by automating routine processes and introducing advanced tools for data collection and analysis, impacting every aspect of human resource management. However, despite rapid advancements in automation, people with their skills, knowledge and even intuition remain the main factor of success. As a result, traditional HR management systems are evolving into talent management platforms that focus on learning, creativity, and intellectual development. As part of such changes, it is crucial to redefine roles, responsibilities, and objectives within HR to align with emerging trends. Table 1 outlines the key trends shaping the future of human resource management.

Table 1. Key trends in HR digital transformation

Trend	Content
Digital HR	A global trend concerning the transformation and integration of digital technologies into various human resource management departments within an organisation. A new stage of development that encompasses the use of digital tools and platforms to optimise processes such as recruitment, personnel management, performance evaluation, and training, aiming to enhance decision-making efficiency.
HR marketing	A strategic approach to talent acquisition, retention, and development that applies marketing principles to attract and retain employees within an organisation. It focuses on building an attractive employer brand, effectively managing communication with potential and current employees, and implementing marketing tools to enhance salary negotiations, career development, and employee satisfaction.
A culture of seamless learning.	An approach that promotes openness, support, and encouragement of the continuous learning and development process for employees at all levels of the organisation. It fosters innovation, enhances effectiveness, and helps the organisation adapt to rapidly changing market conditions. It involves creating an environment where career trajectories and learning opportunities transform into an interactive digital experience, using gamification, VR training, and other platforms and resources for learning. In this environment, each employee feels empowered to self-improve, engages in self-learning, and shares knowledge. This includes supporting access to educational resources, mentoring, regular learning events, and encouraging the open exchange of knowledge.
Machine learning in HR	Machine learning (ML) involves the implementation of artificial intelligence algorithms and models to automate and enhance various aspects of human resource management (talent acquisition, employee analytics, performance management, learning, and development). It enables the analysis of vast amounts of HR data to identify candidates and predict their probability of becoming potential employees. It helps organisations make more informed decisions, improve HR management efficiency, and create more favourable conditions for employee development.
Benchmarking in HR	Benchmarking is a methodology for comparing the practices, processes, and performance indicators of one's own organisation with the best in the industry or similar organisations to identify strengths and weaknesses, as well as opportunities for improvement and their integration (comparing metrics, processes, practices, technologies and tools, culture and strategies, results, and change implementation). It allows for evaluating the underlying causes of existing gaps while making more informed decisions about the appropriate policies and practices that require adjustment.
Automation of HR processes	The implementation of software solutions to simplify, optimise, and automate different aspects of human resource management (recruitment and selection, onboarding, personnel management, training and development, performance evaluation, compensation and benefits, analytics and reporting, communication, and employee engagement, etc.). These systems include applicant tracking systems (ATS), learning management systems (LMS), leave and sick leave management systems, Employee Relationship Management (ERM) systems, payroll automation, performance analysis and reporting, chatbots, and more. Automation helps reduce manual labour, improve accuracy and efficiency, and provide better transparency and control over HR operations, allowing HR professionals to focus on the strategic aspects of personnel management.

Source: created by the authors based on Digital transformation in the HR sphere. What to expect and what the digitalization trends? (n.d.), A. Litorovych (2022)

HR trends are an integral part of the latest societal developments, which are ripening under the influence of the large-scale digitalisation of the economy. As the automation of any economic process is closely linked to changes in the labour market, people – both creators and users of technology –are the primary drivers of digitalisation. Digitalisation is primarily transforming the field of human resources management and then spreading to other industries, which is a natural process of development. According to Deloitte, significant changes have occurred in the operations of HR departments within organisations, driven by digital trends, as illustrated in Table 2.

Table 2. Comparative characteristics of the activities of digital HR management services

Previous Priorities	New Priorities
Focused on developing and harmonising processes to create standard methods of personnel management	Focus on optimising employee productivity, engagement, teamwork and career progression
Selects a cloud technology provider and implements ready-made methods for scaling	Develops innovative programmes and applications for the organisation, using these platforms for scaling
HR technology teams focus on the implementation of ERP (Enterprise Resource Planning) systems and integrated analytics, with particular emphasis on "ease of use"	The HR technology team goes beyond ERP, developing digital capabilities and mobile applications with a focus on "work productivity"
Centres of excellence in personnel management focus on process development and refinement	Utilisation of AI, chatbots and applications to scale and empower employees
Personnel programmes are designed for scale and consistency	Targeted at employee segments, individuals and specific groups, providing them with development plans aligned with their roles and careers
The HR department focuses on "self-service" as a means of scaling services and support	Focuses on "incentivisation", which helps to perform work more efficiently
A self-service portal for employees is created as a technological platform, enabling easy access to transactional needs and programmes	Creates an integrated "employee engagement platform", utilising digital applications, case management, AI and bots to support current individual needs

Source: created by the authors based on P. Occean et al. (2017)

In the study by C. Commisso *et al*. (2024), it was acknowledged that under conditions of rapid changes in the labour market and technological innovations, the importance of supporting both the mental and physical well-being of employees is increasing. Equally critical is ensuring flexibility in managing work processes through the implementation of hybrid and remote work models, as well as adapting management strategies to support new forms of employment. The study concludes that continuous skills development and lifelong learning, strategic talent management (i.e. developing effective programmes for identifying, developing and retaining key employees), the creation of inclusive and supportive corporate cultures, and ensuring a positive working environment are all essential to adapt to changing market conditions.

In the study by H. Bei & H. Sereda (2019), key trends were highlighted, including the use of big data analytics, the automation of recruitment and onboarding, and the application of artificial intelligence to enhance HR processes. Digitalisation offers benefits such as increased efficiency, reduced costs and improved data accuracy; however, it is accompanied by challenges such as high expenditure on new technologies, the need for cultural change, and issues with data security. H. Bei & H. Sereda (2019) recommend developing digital transformation strategies, investing in staff training, and adapting internal processes to new technological realities. Ignoring these processes may seriously affect overall business efficiency, undermine competitiveness and consequently lead to high staff turnover and misalignment with the expectations of newly recruited personnel. The use of digital tools for big data analytics – particularly in relation to human capital – significantly transforms traditional HR practices into digital ones, reduces the workload on specialists and facilitates informed decision-making. The quality, depth and speed of data processing allow for effective planning and workforce management by providing a deep understanding of employees, customers, competitors and business outcomes. In other words, predictive analytics not only improves HR but enhances the business as a whole (Meena & Parimalarani, 2019).

The study by S.H. Rudakova *et al*. (2020) confirmed that digitalisation is fundamentally changing the functions of HR, and that successful digital transformation requires a significant shift in mindset both within HR and across the entire organisation. The authors suggest that the key directions for accelerating the development of companies in the context of digital transformation include teamwork, the modernisation of traditional HR solutions, the development of long-term strategies, and increased employee engagement. They identified specific strategies for implementing digital technologies, such as the integration of mobile applications, social networks, analytics, cloud technologies and VR into HR practices. It is hard not to agree with S.H. Rudakova *et al*. (2020): digital transformation in HR is not limited merely to process automation but entails fundamental changes in personnel management, including the development of digital skills, flexibility in decision-making and the establishment of a new corporate culture that is oriented towards innovation. Without these changes, organisations will find it difficult to fully realise the potential of digital technologies in HR. It is also important to replace outdated HR systems with integrated cloud platforms that establish the digital infrastructure of the enterprise. The impact of digitalisation on personnel management through electronic HR systems (e-HR) is well described in the academic work by E. Baykal (2020), which proposes the integration of e-HR systems as a means of enhancing the efficiency of HR functions and improving organisational performance. The author emphasises the need to use technologies to automate processes such as recruitment, training and staff development, as well as to improve data accessibility and analytics, offering an approach to overcoming the challenges of digitalisation. In the work of E. Baykal (2020) – which analysed the technological advantages of e-HR in terms of efficiency and effectiveness in HRM – it is demonstrated that focusing on core activities,

namely strategic personnel management, can significantly enhance HR process efficiency.

Analysing the impact of digital technologies on personnel management processes leads to the conclusion that digitalisation will contribute to the improvement of management systems in every enterprise. According to L. Kalachevska & K. Naida (2021), this will positively affect the enhancement of flexibility, responsiveness, mobility and deep automation of management processes, which will ultimately increase competitiveness. The application of digital technologies not only provides easy access to necessary resources but also enables remote working, thereby increasing productivity at both the individual and organisational levels. This results in greater employment flexibility, the development of acquired knowledge and practical skills, and an overall improvement in qualification and professionalism. A further advantage is the ability to store and transfer information internationally. The results of this study confirm the findings of the aforementioned scholars. Having explored the possibilities and content of the digitalisation of HR processes, A.M. Ali (2022) notes that it is necessary to consider the factors for their successful integration, which can be divided into technical, organisational and human factors. In this regard, successful digitalisation of HR processes requires a comprehensive approach that takes into account technical, organisational and human factors. On the technical side, it is important to consider the application and characteristics of digital tools such as chatbots, video interviews, data analytics systems, HR automation and talent management systems, as well as data regarding their integration. These tools are designed to enhance the efficiency of personnel management, reduce routine tasks and improve employee engagement. They require integration with existing systems, consideration of data security requirements and careful planning to achieve successful digital transformation in HR. Organisational factors include the specific characteristics and competencies of organisations. The type of digitalisation approach adopted by enterprises and its effectiveness depend heavily on the size of the company, the industry, the field of activity and geographical location. In practice, digital transformation is more common in large and medium-sized businesses, with the private sector more likely to harness the benefits of digitalisation compared to the public sector. Capabilities and resources form another group of organisational factors; difficulties in acquiring and implementing digital tools in business often stem from limited finances, a lack of understanding of the potential of personnel systems or an inadequately equipped workforce for the digitalisation process.

Human factors include the support of senior management and user acceptance. The importance of support from senior management is recognised as one of the key elements for the success of digitalisation. HR managers play a crucial role in ensuring that employees understand the importance of this process. Customer involvement is another component that influences the success of this process. The integration of digital technologies – particularly artificial intelligence – allows for the creation of an employee experience that is focused on the user. These factors underscore the need for a comprehensive approach that considers all aspects for the successful digitalisation of personnel management. Establishing a dedicated team to monitor, analyse and implement new technologies can ensure the development and maintenance of innovation in HR. For a complete understanding of not only the positive aspects but also the potential threats and challenges of digitalising HR processes, it is advisable to employ a SWOT analysis, as illustrated in Figure 2.

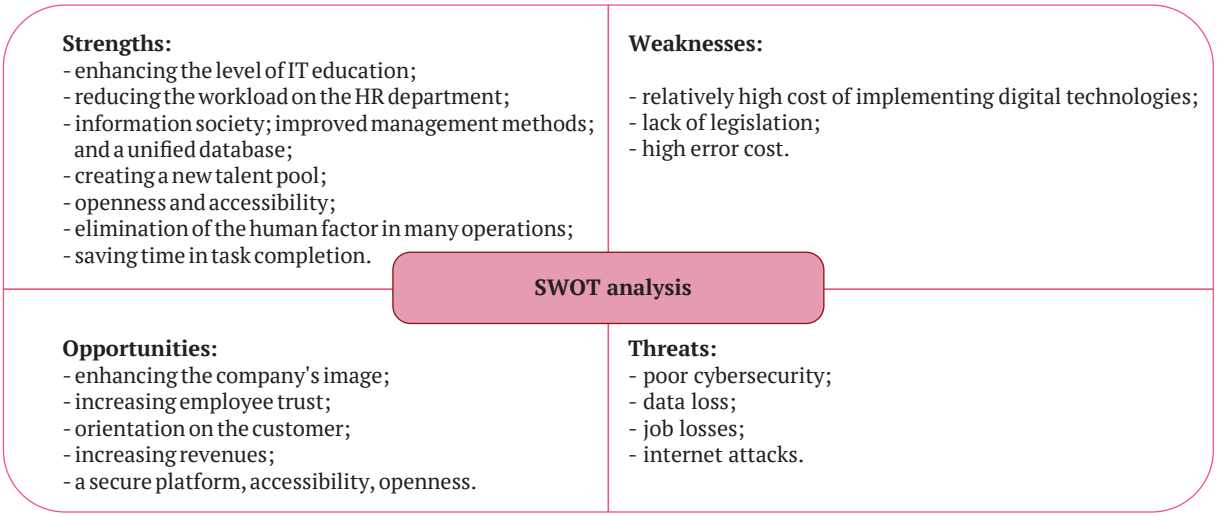

Figure 2. SWOT analysis of the digitalisation of HR processes

Source: created by the authors

The positive aspects of implementing digital technologies in personnel management are numerous and significant. Digitalisation of HR processes opens up considerable opportunities for enhancing efficiency, boosting

employee engagement and increasing the competitiveness of organisations. This is also demonstrated in the work of A. Bansal *et al*. (2023), who defined the digital transformation of personnel management (HRDT) as a multidimensional construct that combines digital and human factors to strengthen the innovative potential of organisations. It considers digital infrastructure, architecture as well as individual capabilities and creativity. The main benefits of digitalising HR processes include raising the level of IT education, reducing the workload on HR departments, creating a centralised database and automating routine tasks, thereby promoting transparency and accessibility by removing the human element from many operations and saving time in task execution. Additionally, digital technologies help attract new talent and enhance the company's image. In order to substantiate the positive impacts of digital HRM transformation as a key factor in social and economic growth, F. Contreras *et al*. (2024) investigated the digital work environment, collaborative culture, digital competencies of employees and other human factors. The authors proposed stimulating research through an interdisciplinary approach and encouraging collaboration between universities, governments and businesses to expand knowledge and support the successful implementation of HRM transformations. Their recommendations are pertinent, as an interdisciplinary approach and collaboration among universities, governments and businesses are key to successful digital HRM transformation. This, in turn, positively influences socio-economic development by improving management processes and creating new opportunities for growth. Nevertheless, there are certain challenges and drawbacks to consider. High costs of implementing digital technologies, a lack of clear legislative regulation and cybersecurity risks, as well as potential system errors and data loss, may pose serious obstacles to full digitalisation of HR processes. Automation and digitalisation may also lead to job cuts, particularly in roles requiring medium and low skill levels. It is important to account for employee resistance – especially among older staff – to change and a lack of motivation to acquire digital skills. Consequently, organisations must carefully plan the integration of digital tools, taking into account potential risks and weaknesses, in order to maximise opportunities and minimise threats. Simultaneously, for optimal personnel management within an enterprise, it is advisable to strike a balance between the use of technology, established processes and the human factor.

According to O. Kipishinova & L. Smetanina (2021), the implementation of any new automated information systems and technologies within personnel management involves a specific sequence of stages: defining the objective of digitalisation; clearly setting tasks – including identifying the problems that need to be solved by the new technologies and describing the expected impact of implementing information technologies; assigning responsible persons and granting them clear authority; selecting the necessary technologies, taking into account the objectives, tasks and problems to be addressed; determining the resource requirements (human, material and financial) for the digitalisation process; outlining internal organisational stages and timelines for their implementation; developing a set of criteria for selecting the firm responsible for deploying the new software within the institution and analysing potential contractors for their compliance with these criteria; reviewing the experience of other institutions in implementing similar information technologies (where available); entering into a contract with the executing firm for system support and maintenance post-implementation; and finally, conducting staff training – bearing in mind that associated training costs must be factored into planning. This sequence of stages confirms that without a clear strategy and a systematic approach, it is impossible to ensure the effective integration of new technologies into the personnel management system and, consequently, to enhance the productivity and competitiveness of the organisation. However, while the overall trend towards digitalisation pushes market participants to meet market demands, an incomplete understanding and immersion in these processes may result in unwarranted significant overspending of financial and time resources.

The conclusions drawn by Deloitte (Kipishinova & Smetanina, 2021) regarding global trends in the development of human capital are based on several key directions: business prosperity depends on the prosperity of people; traditional performance indicators must evolve and be supplemented in light of the significant role played by people; transparency in relationships builds trust; flexible working practices become the norm, contributing to a work–life balance; leadership that focuses on developing and supporting employees is key to success; innovative technologies and digitalisation transform personnel management; inclusivity and diversity within teams enhance creativity and efficiency; continuous training and development of employees should be integral to the company's culture; and corporate social responsibility strengthens a company's reputation and the trust of consumers and partners. The global trends in the development of human capital are aimed at creating conditions for the prosperity of both employees and organisations, emphasising the importance of sustainable development, innovation, transparency and an individualised approach. Organisations are expected to make significant progress in ensuring human resilience, while leaders are tasked with building trust through a well-considered approach to transparency. Unique human abilities – such as creativity and inquisitiveness – are becoming more important than ever, and the way in which human productivity is measured is rapidly changing in response. The application of a holistic approach to HR – where the experiences of people are interwoven with the business system – makes the work of individuals a shared responsibility. Despite the widespread recognition of the importance of motivated human effort, leaders and managers do not always prioritise this, which in turn affects both current and strategic productivity and the overall success of companies.

For the implementation and optimal realisation of digitalisation processes, leadership is crucial. Leadership plays a key role in the digitalisation of HR, as managers determine the direction, set strategic goals and ensure that the necessary resources are available for the successful implementation of innovations. They must inspire and motivate their teams, creating a culture of support and readiness for change. Effective leaders are also able to anticipate potential difficulties and work actively to overcome them – a critical factor for the successful transformation of HR processes. Leaders must demonstrate adaptability and openness to new technologies, encouraging employees to acquire new skills and actively participate in the digitalisation process. Without robust leadership, digitalisation may encounter resistance from staff, significantly hindering the achievement of set goals. Thus, the role of management is decisive in creating the conditions for a successful transition to new, more effective models of personnel management.

Conclusions

Research into digital transformation trends indicates that maximum efficiency and competitiveness in personnel management can only be achieved by balancing technology, processes and the human factor. It has been established that implementing digital tools in the personnel management system is the key to successful business performance in today's information economy. This approach makes the process of managing people within an enterprise more transparent, motivating and directed towards achieving specific goals that consider both the interests of individual employees and the overall strategy of the organisation. Consequently, the labour intensity of HR functions is reduced; management and personnel decisions are expedited; the quality of analytical data is enhanced; the ability to develop forecasts and plans for both current and strategic periods is improved; employees across the globe are better reached; and access is provided to the most modern technological solutions and opportunities for personal development. At the same time, the digitalisation process may face a number of challenges – including high costs for new technologies, potential data security breaches and the need for retraining and upskilling due to technological changes. Social aspects, such as resistance from employees to innovations, must also be taken into account.

It has been demonstrated that successful digital transformation in personnel management requires not only advanced technological solutions but also a strong focus on the human factor, the adaptation of organisational culture and effective change management. Leadership in the digitalisation of HR is not only a factor of success but a necessity for building a modern, competitive and adaptable organisation that is capable of quickly responding to market changes and technological challenges. Future research could focus on a detailed analysis of the impact of modern technologies on HR processes, the development of optimal working models, and the examination of the social and ethical issues related to digitalisation. An important avenue for further investigation should be the development of new metrics and indicators for assessing the effectiveness of personnel management and approaches to retraining employees for working with modern technologies.

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Conflict of Interest

None.

References

[1] Ali, A.M. (2022). *Digitalisation of human resources management*. Retrieved from https://www.researchgate.net/publication/361388981_Digitalisation_of_Human_resources_management.

[2] Bansal, A., Panchal, T., Jabeen, F., Mangla, S.K., & Singh, G. (2023). A study of human resource digital transformation (HRDT): A phenomenon of innovation capability led by digital and individual factors. *Journal of Business Research*, 157, article number 113611. doi: 10.1016/j.jbusres.2022.113611.

[3] Baykal, E. (2020). Digitalization of human resources: e-HR. In Y. Meral (Ed.), *Tools and techniques for implementing international e-trading tactics for competitive advantage* (pp. 268-286). Hershey: IGI Global Scientific Publishing. doi: 10.4018/978-1-7998-0035-4.ch013.

[4] Bei, H., & Sereda, H. (2019). HR-technologies transformation influenced by digitalization of business processes. *Economics and Organization of Management*, 2(34), 93-101. doi: 10.31558/2307-2318.2019.2.10.

[5] Commisso, C., Saha, A.K., Downey, E., Dey, P., Mandal, D., Gupta, A., Hurley, B., & Devan, P. (Eds.). (2024). *Global human capital trends*. London: Deloitte.

[6] Contreras, F., Jauregui, K., & Rank, S. (2024). The intellectual structure of human resource management and digitalization research: A bibliometric-mapping analysis. *Journal of Engineering and Technology Management*, 73, article number 101829. doi: 10.1016/j.jengtecman.2024.101829.

[7] Digital transformation in the HR sphere. What to expect and what the digitalization trends? (n.d.). Retrieved from https://surli.cc/afzqgk.

[8] Eager, J., Whittle, M., Smit, J., Cacciaguerra, G., & Lale-Demoz, E. (2020). *Opportunities of artificial intelligence*. Strasbourg: European Parliament.

[9] HURMA. (2023). *Well-being and AI: What trends await recruiters and HR in 2024*. Retrieved from https://hurma.work/blog/yaki-trendy-chekayut-rekruteriv-ta-hr-u-2024/.

[10] Kalachevska, L., & Naida, K. (2021). The efficiency of agrarian business personnel management in a system crisis. *Efficient Economy*, 10. doi: 10.32702/2307-2105-2021.10.4.
[11] Karpenko, N.M., & Kosinevska, K.O. (2024). HR-trends in the development of human resources of the company. In *Science week 2024* (pp. 348-351). Zaporizhzhia: National University "Zaporizhzhia Polytechnic".
[12] Kipishinova, O., & Smetanina, L. (2021). Digitization of personnel management in public authorities. *Actual Problems of Public Administration*, 3(84), 202-205. doi: 10.35432/1993-8330appa3842021246467.
[13] Kobelia, Z.I., & Todoryuk, S.I. (2022). Digitalization of HR: The future of personnel administration. *Business Inform*, 1, 397-402. doi: 10.32983/2222-4459-2022-1-397-402.
[14] Kolot, A., Lopushniak, H., Kravchuk, O., Varis, I., & Ryabokon, I. (2022). Transferable competencies of HR manager under global socio-economic changes. *Problems and Perspectives in Management*, 20(1), 322-341. doi: 10.21511/ppm.20(1).2022.27.
[15] Kuibida, V.S., Petroie, O.M., Fedulova, L.I., & Androshchuk, H.O. (2019). *Digital competences as a condition for the formation of the quality of human capital*. Kyiv: National Academy for Public Administration under the President of Ukraine.
[16] Litorovych, A. (2022). Features of personnel management in the condition of digitalization. *Economy and Society*, 38. doi: 10.32782/2524-0072/2022-38-34.
[17] Mahoutchian, T., Paynter, N., Scoble-Williams, N., Forsythe, J., Poynton, S., Kamen, M., Kirby, L., Eaton, K., & Van Durme, Y. (2023). *Powering human impact with technology: Technology contributes to making work better for humans and humans better at work™*. Retrieved from https://www2.deloitte.com/us/en/insights/focus/human-capital-trends/2023/human-capital-and-productivity.html.
[18] Meena, M.R., & Parimalarani, G. (2019). Human capital analytics: A game changer for HR professionals. *International Journal of Recent Technology and Engineering*, 8, 3963-3965. doi: 10.35940/ijrte.B1537.0982S1119.
[19] Meet the moment: Navigate change with McKinsey's best 2024 insights. (n.d.). Retrieved from https://www.mckinsey.com/featured-insights/year-in-review.
[20] Murugesan, U., Subramanian, P., Srivastava, S., & Dwivedi, A. (2023). A study of artificial intelligence impacts on human resource digitalization in Industry 4.0. *Decision Analytics Journal*, 7, article number 100249. doi: 10.1016/j.dajour.2023.100249.
[21] Occean, P., Stephan, M., & Walsh, B. (2017). *Digital HR: Platforms, people, and work: 2017 global human capital trends*. Retrieved from https://www2.deloitte.com/us/en/insights/focus/human-capital-trends/2017/digital-transformation-in-hr.html.
[22] Rudakova, S.H., Danylevych, N.S., Shchetinina, L.V., & Kasianenko, Ya.A. (2020). Digital HR – the future of personnel administration. *Business Inform*, 1, 265-270. doi: 10.32983/2222-4459-2020-1-265-270.
[23] Shaulska, L.V., & Hrynkevych, R.I. (2022). The synthesis of management practices at a perfect innovation-active organization. *Business Inform*, 1, 414-423. doi: 10.32983/2222-4459-2022-1-414-423.
[24] Ukrainian Institute for the Future. (n.d.). Retrieved from https://uifuture.org/.
[25] Umantsiv, Yu.M. (2023). Transformation processes in the economy in the context of global competition: Digital dimension. *Economic Theory and Law*, 2(53), 75-84. doi: 10.31359/2411-5584-2023-53-2-75.
[26] Vankevich, A. (2019). The new trends in human resource management in the context of the economy digitalization. *University Economic Bulletin*, 43, 7-12. doi: 10.31470/2306-546X-2019-43-7-12.

Сучасні тренди і практики HR-менеджменту в умовах цифровізації економіки

Наталя Карпенко
Кандидат наук з державного управління, доцент
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0000-0002-9301-3649

Олександр Сафронкін
Аспірант
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0009-0005-4117-8563

Олександр Карпенко
Аспірант
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0009-0004-3701-3769

Олександр Чернов
Аспірант
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0009-0004-3753-0491

Анотація. Дослідження трендів і практик HR-менеджменту в умовах цифровізації економіки є критично важливими для ефективного адаптивного управління персоналом, що сприятиме підвищенню конкурентоспроможності організацій у майбутньому. Метою статті було дослідження трендів і практики HR-менеджменту підприємств в умовах цифровізації економіки. У статті використовувались методи аналізу і синтезу (проаналізовано HR-тренди та практики, проведено синтез даних впливу цифровізації на управління персоналом), систематизації та узагальнення (систематизовано основні тренди HR-менеджменту), абстрагування (виділено загальні принципи та підходи в управлінні персоналом), формально-логічний (структурування дослідження, обґрунтовані логічні висновки). Було досліджено сучасні технологічні зміни і динаміку суспільного розвитку, що відбиваються у зміні HR-трендів і перетворюють управління людськими ресурсами. Визначено зростання ролі HR-функцій, проаналізовано сучасні HR-тренди. Доведено, що під впливом трендів організації обирають стратегічні пріоритети: гібридний формат праці, зосередження на балансі між роботою та особистим життям, автоматизація HR-процесів, розвиток програм добробуту та психічного здоров'я, інвестиції в навчання та розвиток персоналу тощо. Було визначено, що цифрові технології забезпечують легкий доступ до необхідних ресурсів та можливість роботи у віддаленому режимі, що підвищує продуктивність праці на рівні окремих працівників і організацій в цілому. Розкрито позитивні та негативні наслідки цифровізації процесів HR-менеджменту організацій. Для успішної інтеграції цифрових інструментів було обґрунтовано важливість ретельного планування процесу, враховуючи потенційні загрози та слабкі сторони, щоб максимально використовувати можливості та мінімізувати ризики, а також враховувати важливість лідерства у процесі цифровізації HR. Практична цінність дослідження полягає у обґрунтуванні комплексного підходу до реалізації HR-практики, де ключовими факторами є лідерство, підтримка персоналу і готовність до постійних змін у технологічному середовищі

Ключові слова: HR-процеси; цифрова трансформація; персонал; таланти; людські ресурси; управління; організація

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Renewable energy innovations: Synergy of technology and sustainable development

Alla Tkachenko*

Doctor of Economic Sciences, Professor
National University of Zaporizhzhia Polytechnic
69063, 64 Zhukovskoho Str., Zaporizhzhia, Ukraine
https://orcid.org/0000-0002-1843-2579

Vilayat Ibrahim oglu Ismaylov

Doctor of Economic Sciences, Professor
Azerbaijan Academy of Labor and Social Relations
AZ1130, 181 Azadliq Ave., Baku, Azerbaijan
https://orcid.org/0000-0003-0892-0365

Abstract. The paper highlighted the relevance of the topic in the context of global challenges, including climate change, population growth, and the need to decarbonise the economy. The purpose of this article was to substantiate the role of renewable energy innovations, as well as the impact of modern projects, such as new generation offshore wind turbines (Haliade-X, WindFloat Atlantic) on achieving sustainable development. Various types of data analysis and visualisation were used in the writing of the paper. Data and information analysis methods, cross-sectional and descriptive analysis were applied. The main focus was on innovative solutions such as perovskite solar panels, bladeless wind turbines, hydrogen energy systems, new generation battery systems, and integrated smart grids. The authors assume that by 2033, global investment in renewable energy sources will reach $1 trillion per year, and annual savings from lower energy costs and energy efficiency will be up to $450 billion. For Ukraine, investments are projected to grow from $2 billion in 2023 to $40 billion in 2033, which will contribute to energy independence and post-war infrastructure restoration. Developing renewable energy sources will not only diversify exports but also create an environmentally friendly sector of the economy. The article described how innovations in renewable energy sources can reduce dependence on fossil fuels, contribute to the decarbonisation of industry, and improve energy security. The paper considered a synergistic approach to the integration of various technologies, such as solar and wind energy, hydrogen systems, and smart grids. This allowed optimising energy flows and reducing losses, which was important for energy systems. The work created a scientific and practical basis for further research and development, as well as for the widespread introduction of innovations in the field of renewable energy sources. This will ensure sustainable economic growth, economic competitiveness, and environmental issues

Keywords: smart grids; investment; cost; economic effect; decarbonisation; profit; economic recovery

Introduction

Renewable energy was the basis for the transition to sustainable development, given the global need to decarbonise the economy and reduce the negative impact of traditional energy sources. Innovative technologies played a key role in improving renewable energy sources (RES) and their integration into the energy system. The development of renewable energy was a key factor in ensuring sustainable development at the global level. The world is facing numerous challenges that necessitate the transformation of the energy sector. First and foremost, it is global warming caused by greenhouse gas emissions, which poses a threat not only to the environment but also to social and

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*Corresponding author

economic stability. Innovations in this area allowed not only to replace fossil fuels but also to increase the efficiency of energy systems. Global population growth and economic development are steadily increasing the demand for new energy sources. Traditional energy sources cannot meet this demand without significant environmental consequences. Renewable energy sources provided a stable energy supply thanks to the latest technologies in energy production, storage and distribution. Geopolitical conflicts have demonstrated the vulnerability of countries that are dependent on fossil fuel imports. The introduction of innovations in RES contributed to the creation of energy-independent systems, which was especially important for Ukraine in the context of post-war reconstruction.

Innovations in renewable energy created new opportunities for investment, technology development, and job creation. According to the International Renewable Energy Agency (IRENA & AfDB, 2022; IRENA, 2023), every investment in renewable energy had a multiplier effect on the economy, creating additional employment sectors. Innovative solutions, such as perovskite solar panels, hydrogen energy systems, offshore wind farms, and artificial intelligence in power grids, were changing the way the energy sector is viewed. These and other technologies can provide the desired flexibility and adaptability of energy networks in the future. For Ukraine, innovations in renewable energy have a double meaning: a way to reduce dependence on fossil fuels, while renewable energy can become a driver of infrastructure reconstruction in the post-conflict period, and the export of Ukrainian "green" technologies will help strengthen the country's international credibility. Innovation is becoming a factor that not only contributes to solving environmental and energy problems, but also ensures sustainable growth and competitiveness of the economy.

The literature analysis focused on works that explore current trends in renewable energy development and innovation. They emphasised the importance of technological progress in reducing the cost of energy, in particular through perovskite panels and new generation batteries. According to Ukrainian scientists L. Melnyk *et al*. (2019), renewable energy sources had undeniable prerogatives. IT was more environmentally friendly than conventional means of energy production based on the combustion of natural fossil fuels and had a number of undoubted qualities that distinguish them from traditional energy facilities. These scientists emphasised that renewable energy sources were relatively stable, which allowed them to cover the sustainable operation of energy systems. S. Kudrya (2020) emphasised that the use of environmentally friendly renewable energy sources to cover the country's energy needs was very valuable for Ukraine. In most civilised countries, the use of renewable energy sources was a priority vector for the development of the energy sector, due to the tendency to eliminate energy instability in countries associated with existing energy crises and reduce the number of toxic emissions that occur when using conventional energy sources. A notable aspect was the prospect of creating reserves of natural raw materials for non-energy needs and preserving energy resources in the future.

Based on the position of the Executive Director of the International Energy Agency (IEA) Fatih Birol, A. Frangoul (2022) emphasised that the energy crisis has become a catalyst for the transition to the newest stage of development of renewable energy sources, accompanied by their intensive growth, driven by the desire of states to strengthen their energy security. This study noted that according to the International Energy Agency, by the middle of this decade, renewable energy sources will outgrow the use of coal and become the most powerful source of electricity in the world. The IEA report (2022a) predicted a significant reshaping of the global energy balance amid growing global instability and geopolitical tensions. It is noted that the first truly global energy crisis caused by the Russian Federation's invasion of Ukraine has given an unprecedented impetus to the development of renewable energy.

D. Orlova & D. Sydoro (2021) pointed out that there has been a steady increase due to the transition of the modern economy to green energy. Offshore wind energy was being deployed in Europe due to large partial capacities. In Ukraine, the situation was still different – the country needs to consume resources for onshore wind farms. The focus was on adapting innovations to national conditions, overcoming regulatory barriers and developing the necessary infrastructure. Scientists have focused on the economic effects of innovations, exploring the synergistic approach to the integration of different technologies, which reduces energy losses and increases the stability of the power system. The purpose of the article was to analyse the role of innovation in the development of renewable energy, identify key technological breakthroughs and outline their impact on sustainable development.

Materials and Methods

The research was based on reliable analytical sources, statistical reports of international and national organisations, as well as scientific papers covering current technological trends in the field of renewable energy. The basis of the source base was formed by IRENA's annual reports (IRENA, 2023; IRENA & AfDB, 2022), and IEA analytical reviews (IEA, 2022a; IEA, 2022b; IEA, 2024). A separate group included reviews and forecasts of investment flows in the RES sector, presented in the reports Bloomberg New Energy Finance (2023) and Global clean energy investment jumps 17%, hits $1.8 trillion in 2023, according to BloombergNEF report (2024), which assess the dynamics of capital attraction in green technologies. This data was used both to describe global trends and to forecast investment activity in Ukraine. The national context of the study was covered on the basis of official publications by National Power Company Ukrenergo (n.d.), State Agency on Energy Efficiency and Energy Saving of Ukraine (n.d.), and Energy strategy (2022).

The study was based on a combination of quantitative and qualitative methods of analysis. Factor analysis was used to identify the key determinants of innovative development of renewable energy sources. Correlation analysis was used to establish the relationship between the level of innovation, energy cost and investment volume. Regression modelling allowed for a quantitative assessment of the impact of innovation on the economic performance of energy systems. The long-term effects of technology adoption in the period up to 2033 were modelled using scenario analysis. To empirically test the formulated hypotheses, the cases of the Hybrit (Sweden) and Hornsea One (Denmark) projects were analysed. Statistical data were processed using descriptive analysis and further visualisation of data in the form of graphs and tables. Life Cycle Analysis (LCA) was applied to assess the environmental impacts.

The reliability of statistical data was ensured by cross-checking information from several independent sources. The combination of these methods made it possible to achieve high analytical accuracy and comprehensiveness of the results obtained, which were presented in detail in the following sections of the study. In writing the paper, a method of verifying information such as assessing the credibility of the source was used. If the work referred to another source, the reliability of the information provided was checked, in particular, the reliability of quoting the source. Cross-checking was used: comparing information from several sources. This method was used if it was difficult to find the original source or if the information was quoted. The use of cross-checking made it possible to reduce the likelihood of using questionable information, which allowed for greater accuracy in obtaining results.

In preparing the article, the following methods of information analysis were used: factor analysis (which identified the primary factors that determine the role of innovation in the development of renewable energy) and descriptive analysis of indicators (which presented information in the form of visualisation in graphs and tables, which in turn is aimed at deepening the perception of the study, and also allows for a more comprehensive disclosure of trends and illustration of their dynamics), for example, sorting, filtering and visualisation were used. Regression analysis of indicators (to determine the correlation of the impact on renewable energy cost reduction), correlation analysis (to formulate the relationship between different aspects of renewable energy development and innovation), as well as data decomposition and hypothesis analysis were used in writing the paper. Among other things, trend analysis was used to understand and predict various trends and developments in the development of renewable energy, which is a key factor in ensuring sustainable development at the global level.

Results and Discussion

The article described in detail the main approaches to the analysis of the systems approach, which will allow to consider RES innovations as an integral part of the energy, environmental and economic systems, studied the role of innovations in the creation of smart grids and integration of RES into traditional energy systems, assess the impact of energy storage technologies and decentralised energy systems, analysed the economic effects of large-scale implementation of RES innovations, in particular the impact on the cost of electricity (Jacobson & Delucchi, 2011). The use of SWOT and PESTEL analysed is also an effective tool for the introduction of RES (IRENA & AfDB, 2022). At the same time, empirical analysis cannot be ignored, and most importantly, quantitative analysis (analysis of the dynamics of investment in RES, changes in energy costs, and the level of innovation) and case studies (research on successful projects such as Hybrit in Sweden (hydrogen energy) or offshore wind projects in Denmark), as the use of real statistical data allowed assessing the impact of innovations on the energy system (Bloomberg New Energy Finance, 2023).

One of the key technological breakthroughs was made by perovskite solar panels, which significantly changed the economics of solar generation. The high efficiency (25-30% on average) and significantly lower production costs compared to traditional silicon analogues made this technology promising for mass adoption by small and medium-sized businesses and the private sector. An example of commercial implementation is the development of Oxford PV (UK), where the innovative composition of the material helped to reduce the cost of electricity by more than 30%. Hydrogen power systems were equally important, as they allow the accumulation of excess energy from renewable sources and its use in industry or transport. The Hybrit project in Sweden was an example of the effective use of hydrogen for decarbonising steel production, with a 90% reduction in CO_2 emissions. The implementation of such systems allowed energy-intensive enterprises to reduce their dependence on fossil fuels while reducing the cost of utilising excess energy.

Offshore wind farms also had significant potential, as they demonstrate a significant increase in electricity production due to better wind conditions offshore. One of the largest completed projects is Hornsea One (Denmark), which has increased energy production by almost 50% compared to onshore wind farms. For countries with access to the sea coast, the implementation of such projects meant the possibility of strengthening energy independence without putting a significant burden on land infrastructure. All of these examples demonstrate that renewable energy innovations not only had a technical advantage, but also created economically viable incentives for commercial implementation, including at the level of enterprises of various industries. It was also important to note that the decline in the cost of renewable energy in 2010-2023 had a positive trend (Fig. 1)

According to IRENA & AfDB (2022), Bloomberg New Energy Finance (2023), IEA (2022b), the share of innovations in RES by technology in 2023 was as follows (Fig. 2).

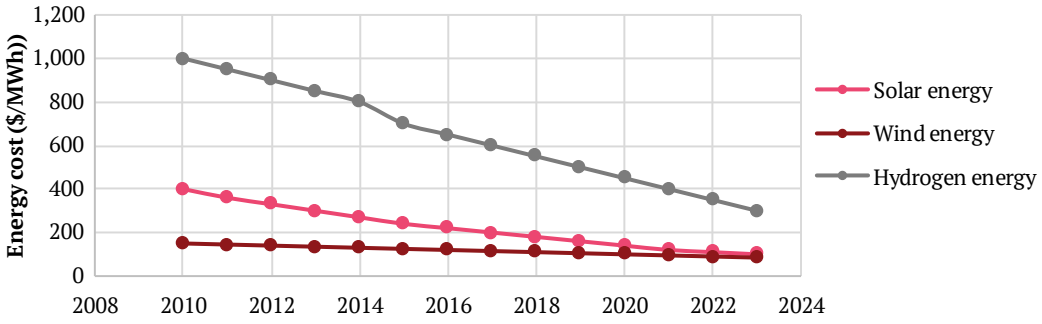

Figure 1. Dynamics of renewable energy cost reduction (2010-2023)
Source: created by the authors based on IRENA & AfDB (2022), IEA (2022a), Bloomberg New Energy Finance (2023)

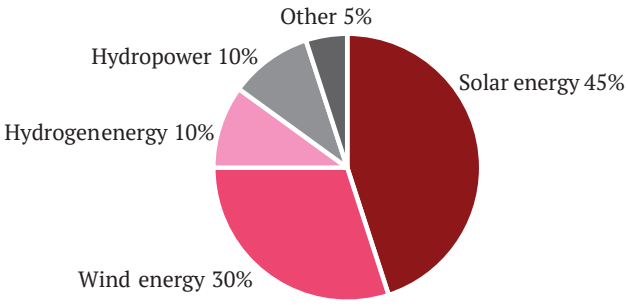

Figure 2. Share of innovations in RES by technology (2023)
Source: Systematised based on analytical materials of IRENA (2023), Bloomberg New Energy Finance (2023), L. Mykhailova, & O. Dumansky (2024)

Modern offshore wind turbines were primarily characterised by innovative designs with increased capacity and efficiency. Thus, it was worth considering a synergistic approach to the introduction of renewable energy. Such a scheme should demonstrate the interconnection between solar energy (solar panels), wind energy (turbines), hydrogen energy (electrolysis plants) and energy storage systems (batteries, grid integration). The central hub was represented as a smart grid that coordinates all the components. The connections between the elements illustrated energy flows and optimisation through monitoring and feedback. Thus, it was a combination of four elements: production (solar and wind farms), storage (batteries, hydrogen), distribution (smart grids) and consumption (smart homes, transport). To compare the key RES technologies, Table 1 showed the rationale for this approach.

Table 1. Comparison of key RES technologies

Technology	Efficiency (%)	Cost ($/MWh)	Environmental impact (low/medium/high)	Potential for use
Solar panels (perovskite)	25-30	40-60	Low	High
Wind turbines (offshore)	35-50	50-70	Medium	High
Hydrogen energy	45-55	60-100	Low	Medium
Hydropower	80-90	30-50	High	Limited

Source: compiled from IRENA & AfDB (2022), IEA (2022a), Bloomberg New Energy Finance (2023), G. Squadrito *et al.* (2023), O. Fedorenko (2024)

The comparative analysis of key renewable energy innovations allowed to form a holistic view of the potential of each technology in the context of its practical implementation in the economy. The data showed a significant difference between technologies not only in terms of efficiency and cost, but also in terms of environmental impact and the extent of adaptation to market conditions. For example, the high efficiency of hydropower was combined with limited potential for expansion due to environmental constraints and geographical specificity. In contrast, hydrogen power and new generation battery systems had an average power level, but offer high flexibility in use and scalability. Perovskite panels strike a balance between low cost and high application potential, making them strategically attractive for energy-active businesses. Offshore wind power, despite its complexity, demonstrated the highest generation stability and long-term economic returns. It was the integration of these technologies at the level of enterprises and territorial communities that was the best way to achieve economic efficiency, decarbonise production and reduce the energy dependence of national economies. This approach met the current challenges of sustainable development and forms the basis for new business models in the green economy. The growth rate of installed RES capacities from 2010 to 2023 was shown in Figure 3. Table 2 provided a comprehensive overview of the key renewable energy innovations, including their advantages, disadvantages, implementation opportunities and estimated timeframes. These technologies were important for achieving energy independence, decarbonising the economy and integrating Ukraine into the global energy market.

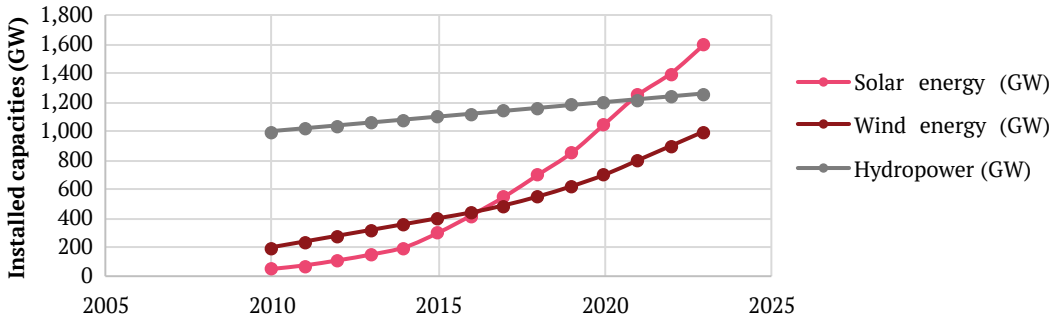

Figure 3. Growth rates of installed RES capacities (2010-2023)
Source: built by the author based on the analysis of IRENA & AfDB (2022), Bloomberg New Energy Finance (2023), O. Fedorenko (2024)

Table 2. Modern innovations in the field of renewable energy

Innovation	Advantages	Disadvantages	Opportunities for implementation	Estimated year of implementation
Perovskite solar panels	Higher efficiency and cheaper production compared to standard panels	Shorter service life, need for large-scale production	Widespread use in residential and industrial buildings	2025-2030
Bladeless wind turbines	Less noise, less impact on wildlife, easier maintenance	Require new structures and infrastructure for installation	Suitable for remote regions and offshore wind farms	2028-2035
Hydrogen fuel cells	Possibility of energy storage and transportation, low emissions	High production costs, insufficient infrastructure	Ensuring the decarbonisation of heavy industry and transport	2025-2040
New generation battery systems (solid-state batteries)	Higher energy density, faster charging, longer service life	High cost, need to improve technology	Use in electric vehicles and stationary energy storage	2025-2030
Smart grids	Optimisation of energy flows, reduction of grid losses	Requires significant investment in digitalisation	Integrating renewables into the national grid	2025-2035

Source: compiled based on IEA (2022b), IRENA (2023), G. Squadrito *et al*. (2023), L. Mykhailova *et al*. (2023), Global clean energy investment jumped 17% to $1.8 trillion in 2023, according to BloombergNEF (2024)

Perovskite solar panels offered higher efficiency in energy production and had lower manufacturing costs than standard silicon panels, which was important for Ukraine. The main problem was the shorter lifespan and the need for large-scale production, which was not yet established in Ukraine. The next innovation, bladeless wind turbines, were more environmentally friendly (less impact on wildlife) and easier to maintain than traditional turbines. It also reduced noise, making it more acceptable to the public, and was suitable for use in remote regions of Ukraine and in the Black Sea, where offshore turbines can operate efficiently. However, its implementation required an installation infrastructure that was not yet available in Ukraine. The scientific community was actively considering the possibilities of hydrogen energy, which allowed storing excess energy from renewable sources, which in turn was important for the stability of the power system.

Hydrogen can be used in industry and transport, and for Ukraine, this was a real chance to decarbonise heavy industry (e.g., metallurgy) and develop green hydrogen exports to the EU. The biggest obstacle to the introduction of hydrogen energy was the high cost of hydrogen production and insufficient infrastructure for its transportation and storage. New generation battery systems (solid-state batteries) were increasingly being used in transport, providing a longer service life, higher energy capacity and faster charging, which was critical for the development of the electric vehicle sector and energy storage in Ukraine. This technology was relatively expensive and required large-scale production, but its potential for use in transport and for stabilising the power system, especially during peak loads, cannot be overestimated. It was worth emphasising the importance of building a smart grid, a system that allowed for the integration of different energy sources into a single network, optimising its operation and reducing losses, and can reduce dependence on fossil fuels. Despite the high level of digitalisation, such a system required significant investments in further digitalisation and infrastructure modernisation. For Ukraine, the introduction of these technologies was strategically important. The development of RES will contribute to energy independence, economic growth and environmental sustainability. Attracting investment, adopting advanced technologies and integrating into European energy markets will make these innovations a reality in the coming decades.

Azerbaijan was a striking example of a successful transition to alternative energy sources with huge renewable energy potential. Despite the fact that the formation of modern Azerbaijan was inextricably linked to oil production, it was a leader in the region in applying innovative

approaches aimed at the transition to green energy and makes a significant contribution to combating the effects of climate change. It was worth noting that the 29th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP29) was held under the Azerbaijani presidency on 11-22 November 2024. By order of the President of Azerbaijan, 2024 has been declared the 'Year of Solidarity for a Greener World', and the country intends to reduce greenhouse gas emissions by 35% by 2030 and 40% by 2050 compared to 1990. In terms of Azerbaijan's potential, important memoranda of understanding and agreements have been signed between Azerbaijan and international energy companies that will allow for the production of up to 22 GW of wind and solar energy onshore, 10 GW of wind and solar energy in the territories liberated during the 2020 war, and 157 GW of wind energy in the Azerbaijani sector of the Caspian Sea. In total, this potential is almost 200 GW. While Azerbaijan has previously accumulated a large amount of investment in the oil and gas sector, in 2024, the country's main goal is to develop renewable energy sources and maintain leadership in the region.

As for the economic effect of the introduction of renewable energy, global investment in renewable energy is expected to grow from $200 billion to $1 trillion per year by 2033. This is due to the large-scale introduction of new technologies such as perovskite panels, hydrogen systems and smart grids. Thanks to lower energy costs, reduced expenditures on fossil fuels and improved energy efficiency, annual savings of up to $450 billion are expected by 2033 (Fig. 4).

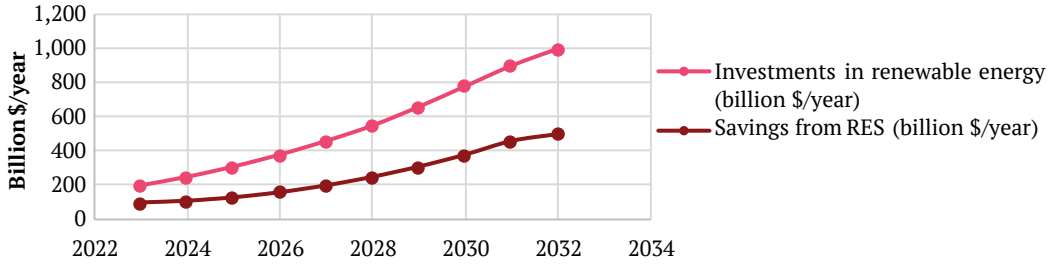

Figure 4. Economic impact of RES innovations in the world (forecast 2023-2033)
Source: IRENA & AfDB (2022), G. Squadrito *et al.* (2023), IEA (2024)

The economic effect of innovations in Ukraine (2023-2033) was projected to be achieved through an increase in investment in the Ukrainian renewable energy sector from $2 billion in 2023 to $40 billion in 2033. This was due to the post-war rebuilding of infrastructure, attracting international assistance and developing export potential. The introduction of new technologies will allow Ukraine to save up to $12 billion annually by reducing energy import costs, decarbonising the industry, and improving energy security (Fig. 5).

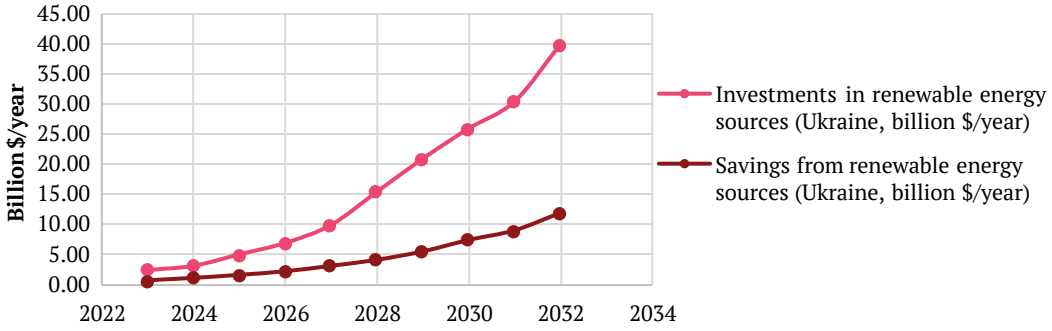

Figure 5. Economic impact of RES innovations in Ukraine (forecast 2023-2033)
Source: IRENA & AfDB (2022), Energy strategy (2022), G. Squadrito *et al.* (2023), IEA (2024)

Thus, intensifying innovative development in the renewable energy sector was a key task for countries seeking to achieve energy independence and to reduce their carbon footprint and ensure economic sustainability. In this context, it was necessary to focus on several strategic areas. Governments and the private sector should invest in research aimed at reducing the cost of technologies and increasing their efficiency. The development of perovskite solar panels, which were more cost-effective than silicon, but required large-scale testing. Another important role was to stimulate research in higher education institutions and cooperation with industrial partners that will promote innovation, as well as support for research and development, since the development of innovations in renewable energy depended on the creation of new materials, technologies and solutions. In addition, favourable conditions for investors will also contribute to the development of innovations, as investment is the main driver of innovation, and

therefore the introduction of tax breaks, grants and subsidies for companies investing in RES will help accelerate their development. Infrastructure development has also been an important focus of this development vector, as high-tech infrastructure is the basis for integrating renewable energy sources into national energy systems. The integration of smart grids will enable more efficient management of power flows, reduce losses and stabilise the power system. Investments in new generation battery systems will help solve the problem of uneven power generation. The development of the regulatory framework should also be taken into account, as modern legislation should stimulate the development of RES and ensure a level playing field for market participants, which in turn will help make investments in RES more attractive for businesses. International cooperation, exchange of experience and technologies with developed countries will help accelerate innovation development. Education and training of personnel are also important for the successful development of renewable energy, which may include the introduction of specialised courses on renewable energy in higher education institutions, organisation of training for energy sector employees on how to work with new technologies, etc. Raising public awareness by disseminating information about the benefits of RES through the media and educational programmes, as public support is an important factor for innovation, and creating local RES projects with the involvement of the public, which will help to increase confidence in the technologies.

Ya. Kotyk (2024) focused on the implementation of the mechanism of guarantees of electricity origin as a tool to stimulate the development of renewable energy in Ukraine, comparing the EU experience. The authors agreed with these findings, as such mechanisms do promote investment and transparency in energy markets. This was consistent with this research on renewable energy innovation as a driver of energy security and sustainable development. The authors G. Squadrito *et al*. (2023) investigated the advantages and disadvantages of different green hydrogen production technologies, including biomass pyrolysis and water electrolysis, favouring the latter as the most promising for large-scale implementation. The authors also analysed geopolitical and economic challenges, in particular the threat of an aggravation of the water crisis. This position should be agreed with, since the integration of green hydrogen really requires a comprehensive approach that takes into account not only technological but also socio-economic aspects.

Population growth and the development of national economies were leading to an increase in demand for energy resources. Traditional energy sources were unable to meet this growth without significant negative impact on the environment. In this context, renewable energy sources (RES) were a tool for ensuring stable energy supply through the introduction of modern technologies in the field of energy production, storage and distribution. Geopolitical instability, in particular the dependence of some countries on fossil fuel imports, has highlighted the need to move to energy self-sufficient systems. For Ukraine, this approach was of particular importance in the context of post-war reconstruction. As noted by S. Kudrya (2020), the use of environmentally friendly RES contributed to the energy security of Ukraine, which was characterised by a shortage of its own energy resources. The introduction of RES has been identified as a priority area of energy development in most developed countries. This was driven by the need to eliminate energy instability and reduce emissions of harmful substances typical of traditional energy sources.

An additional advantage was the preservation of natural raw materials for non-energy needs and the formation of strategic reserves. According to the position of IEA Executive Director Fatih Birol, quoted in A. Frangoul (2022), and which the authors of the study consider to be correct, the energy crisis has intensified the transition to a new stage of RES development, accompanied by their rapid growth, driven by the desire of states to strengthen energy autonomy. The IEA report (2022b) predicted a significant change in the structure of the global energy balance in the face of geopolitical tensions. The document stated that the first global energy crisis caused by the Russian Federation's armed aggression against Ukraine has strengthened the momentum of renewable energy development.

L. Mykhailova & O. Dumanskyi (2024) analysed the introduction of innovative technologies in Ukraine's green energy sector in the context of European integration and sustainable development, in particular artificial intelligence, smart grids and green auctions. The authors pointed out the prospects of solar energy and the role of IT solutions in restoring the energy system. This approach seemed appropriate as it combined technological modernisation with the environmental and economic strategy of post-war transformation. The study by the State Agency on Energy Efficiency and Energy Saving of Ukraine (n.d.) and the BloombergNEF analytical report (2024) highlighted the growth of global investment in the RES sector, as well as the expansion of smart grids. It was noted that clean energy sources, green technologies, hydrogen, electric transport, and carbon reduction initiatives have become key determinants of investment growth. In 2023, total investment in low-carbon projects reached USD 1.77 trillion, a record high. This data demonstrated the sustainability of the global energy transition.

The reports, in particular, by National Power Company Ukrenergo (n.d.) and the European Bank for Reconstruction and Development (n.d.), focused on the specifics of RES development in Ukraine. The analysis of innovations in this area required an interdisciplinary approach, taking into account economic, technological, environmental and social factors. According to the recommendations of the IEA (2022a; 2022b), methods of analysing innovation development should include economic modelling, which involves forecasting the structure of the energy market, costs and revenues, as well as scenario analysis to determine the long-term consequences of the introduction of new technologies, including the transition to hydrogen

energy. Authors E.G. Hertwich & R. Wood (2018) considered that environmental assessment should be carried out using LCA (Life Cycle Assessment) methodology, which includes determining carbon footprint, biodiversity and water resource impacts. Enhancing the innovative development of renewable energy required a comprehensive approach that includes support for research, favourable conditions for investment, infrastructure development and training of qualified personnel. In the context of Ukraine, these measures should be seen as the basis for energy independence and sustainable economic growth.

Conclusions

Innovations in renewable energy were key to transforming modern energy systems. Technologies such as perovskite solar panels, bladeless wind turbines, hydrogen systems and smart grids not only contributed to decarbonisation, but also created significant economic benefits by reducing energy costs. Innovations helped to reduce the cost of energy production and increase its availability. Global investment in renewable energy is expected to reach $1 trillion annually by 2033, with savings of $450 billion, which will help develop renewable energy innovations, energy independence, attract international investment and restore infrastructure. The development of renewable energy was not only a challenge but also a chance to become a leader, and Azerbaijan was a vivid example of such development for Ukraine.

Important areas included the integration of innovations into the national energy system, the development of smart grids, and the transition to a closed-loop economy. To boost innovation development, it was necessary to focus on government support for research, creating a favourable investment climate, infrastructure modernisation, international cooperation and training. Further research should focus on the adaptation of advanced technologies to the conditions of specific countries, including Ukraine, the development of integrated energy systems, the use of digital tools for energy management, and the development of economic models for assessing the impact of innovations on national economies. Further research will help create more effective models for implementing innovations, ensuring sustainable development of the economy and society. A review of the collected sources indicated the need for further development of models for assessing the economic efficiency of innovations, the development of energy storage technologies, and the use of Big Data to manage energy flows, and thus the development of RES was a complex challenge that requires the efforts of the scientific community, governments and businesses.

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None.

Conflict of Interest

None.

References

[1] Bloomberg New Energy Finance. (2023). *Energy transition investment trends*. Retrieved from https://assets.bbhub.io/professional/sites/24/energy-transition-investment-trends-2023.pdf.
[2] Energy strategy. (2022). Retrieved from https://mev.gov.ua/reforma/enerhetychna-stratehiya-0.
[3] European Bank for Reconstruction and Development. (n.d.). Retrieved from https://www.ebrd.com.
[4] Fedorenko, O. (2024). *Japanese vertical wind turbines: A new stage in the development of offshore energy*. Retrieved from https://kreschatic.kiev.ua/tehno/2024/09/12/yaponski-vertykalni-vitryaky-novyj-etap-u-rozvytku-ofshornoyi-energetyky.html.
[5] Frangoul, A. (2022). *Renewables to overtake coal and become world's biggest source of electricity generation by 2025, IEA says*. Retrieved from https://www.cnbc.com/2022/12/06/renewables-to-be-main-source-of-electricity-generation-by-2025-iea.html.
[6] Global clean energy investment jumps 17%, hits $1.8 trillion in 2023, according to BloombergNEF report. (2024). Retrieved from https://about.bnef.com/blog/global-clean-energy-investment-jumps-17-hits-1-8-trillion-in-2023-according-to-bloombergnef-report/.
[7] Hertwich, E.G., & Wood, R. (2018). The growing importance of scope 3 greenhouse gas emissions from industry. *Environmental Research Letters*, 13(10), article number 104013. doi: 10.1088/1748-9326/aae19a.
[8] IEA. (2022a). *World Energy Outlook 2022*. Paris: International Energy Agency.
[9] IEA. (2022b). *Renewables 2022*. Vienna: IEA.
[10] IEA. (2024). *Renewables 2023: Analysis and forecast to 2028*. Paris: International Energy Agency.
[11] IRENA & AfDB. (2022). *Renewable energy market analysis: Africa and its regions*. Abu Dhabi: International Renewable Energy Agency.
[12] IRENA. (2023). *World energy transitions outlook 2023*. Retrieved from https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2023.
[13] Jacobson, M.Z., & Delucchi, M.A. (2011). Providing all global energy with wind, water, and solar power, part I: Technologies, energy resources, quantities and areas of infrastructure, and materials. *Energy Policy*, 39(3), 1154-1169. doi: 10.1016/j.enpol.2010.11.040.
[14] Kotyk, Ya. (2024). Guarantees of electricity origin as a financial mechanism to increase investment attractiveness in the energy sector. *University Economic Bulletin*, 19(1), 17-25. doi: 10.69587/ueb/1.2024.17.

[15] Kudrya, S. (Ed.). (2020). *Renewable energy sources*. Kyiv: The Institute of Renewable energy of the National Academy of Sciences of Ukraine.
[16] Melnyk, L., Karintseva,O., & Dehtyarova, I. (2019). "Green" energy as a leading link of the "green" economy: The experience of the European Union. In P. Makarenko, O. Kalinichenko & V. Aranchii (Eds.), *Energy efficiency and energy saving: Economic, technical, technological and ecological aspects* (pp. 85-91). Poltava: PC "Astraya".
[17] Mykhailova, L., & Dumansky, O. (2024). Innovative technologies in green energy: Prospects and challenges. *Science and Technology Today*, 2(30), 899-909. doi: 10.52058/2786-6025-2024-2(30)-899-909.
[18] Mykhailova, L., Semenyshyna, I., & Shpatakova, O. (2023). Green energy as a factor of energy independence of Ukraine. *Economy and Society*, 47. doi: 10.32782/2524-0072/2023-47-10.
[19] National Power Company Ukrenergo. (n.d.). Retrieved from https://ua.energy/en/.
[20] Orlova, D., & Sydoro, D. (2021). *Igor Nus: "The peak of wind farm construction in Ukraine is far ahead of us"*. Retrieved from https://expro.com.ua/statti/gor-nus-pk-budvnictva-ves-v-ukran-cheka-nas-daleko-poperedu.
[21] Squadrito, G., Maggio, G., & Nicita, A. (2023). The green hydrogen revolution. *Renewable Energy*, 216, article number 119041. doi: 10.1016/j.renene.2023.119041.
[22] State Agency on Energy Efficiency and Energy Saving of Ukraine. (n.d). Retrieved from https://saee.gov.ua/en.

Інновації у сфері відновлюваної енергетики: синергія технологій та сталого розвитку

Алла Ткаченко
Доктор економічних наук, професор
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0000-0002-1843-2579

Вілаят Ібрагім огли Ісмайлов
Доктор економічних наук, професор
Азербайджанська академія праці та соціальних відносин
AZ1130, просп. Азадлиг, 181, м. Баку, Азербайджан
https://orcid.org/0000-0003-0892-0365

Анотація. У роботі висвітлено актуальність теми в контексті глобальних викликів, зокрема кліматичних змін, зростання населення, та необхідності декарбонізації економіки. Мета даної статті – обґрунтування ролі інновацій для відновлюваної енергетики, а також вплив сучасних проектів, таких як офшорні вітрові турбіни нового покоління (Haliade-X, WindFloat Atlantic) на досягнення сталого розвитку. Під час написання роботи використовувались різні види аналізу та візуалізації даних. Було застосовано методи аналізу даних та інформації, перехресний та описовий аналіз. Основний акцент зроблено на таких інноваційних рішеннях, як перовськітні сонячні панелі, безлопатеві вітрові турбіни, водневі системи енергозабезпечення, акумуляторні системи нового покоління та інтегровані смарт-мережі. Авторами передбачається, що до 2033 року світові інвестиції у відновлювані джерела енергії сягнуть $1 трлн на рік, а щорічна економія від зниження собівартості енергії та енергоефективності становитиме до $450 млрд. Для України прогнозується зростання інвестицій з $2 млрд у 2023 році до $40 млрд у 2033 році, що сприятиме енергетичній незалежності та післявоєнному відновленню інфраструктури. Зазначено, що, розвиваючи сферу відновлюваних джерел енергії вдасться не лише диверсифікувати експорт, а й створити екологічно чистий сектор економіки. Описано, як інновації у відновлюваних джерел енергії дозволяють зменшити залежність від викопного палива, сприяють декарбонізації промисловості, а також покращують енергетичну безпеку. Робота розглядає синергетичний підхід до інтеграції різних технологій, таких як сонячна та вітрова енергетика, водневі системи та смарт-мережі. Це дозволяє оптимізувати енергетичні потоки та зменшити втрати, що актуально для енергетичних систем. Робота створює науково-практичну базу для подальших досліджень і розробок, а також для широкого впровадження інновацій у сфері відновлюваних джерел енергії, що забезпечить стале економічне зростання, конкурентоспроможність економіки та вирішення екологічних проблем

Ключові слова: смарт-мережі; інвестування; собівартість; економічний ефект; декарбонізація; прибуток; економічне відновлення

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The interrelation between the development of artificial intelligence technologies and the global economy and labour market

Alla Khanenko*

PhD in Economic Sciences, Associate Professor
National University "Zaporizhzhia Polytechnic"
69063, 64 Zhukovsky Str., Zaporizhzhia, Ukraine
https://orcid.org/0000-0003-0899-7311

Abstract. The supporting, and increasingly leading, role of artificial intelligence (AI) was observed to become more evident across multiple spheres of public life. AI, encompassing a broad range of sectors, was found to exert growing influence on the development of modern business, facilitating the implementation of more efficient and innovative management methods. The aim of the article was to examine the impact of AI on the development of the global economy and the world labour market, to identify the interrelation between AI advancement and national economic growth, and to highlight, within the informational space, the historical influence of technological revolutions on reducing labour demand. To achieve this objective, a comprehensive range of theoretical research methods was employed, including monitoring, statistical analysis, comparative and systems analysis, verification, synthesis and generalisation, analysis of existing approaches, and assessment of efficiency and effectiveness. Academic publications were used as source material. The economic sectors most actively adopting AI technologies were identified, with an emphasis placed on their potential for further development. The findings indicated that the most active business sectors in implementing AI technologies included retail, IT and telecommunications, healthcare, the automotive industry, tourism and hospitality. The analysis confirmed that the integration of AI technologies into business operations had the potential to significantly increase company revenue, enhance operational efficiency, and improve competitiveness. A growing number of companies worldwide were found to be engaged in the development of AI solutions, ranging from general-purpose tools to highly specialised products. Recommendations were presented regarding potential strategies for addressing challenges associated with the implementation of generative AI technologies and their impact on the formation of the Ukrainian labour market

Keywords: unemployment; generative artificial intelligence; automation; intelligent robots; information technologies

Introduction

The industry of artificial intelligence (AI) experienced rapid development. By fostering the implementation of innovative technologies, AI attracted the attention of leading global business figures and exerted an increasingly significant influence on the development of modern enterprises. The growing impact of AI on the efficiency and competitiveness of companies became increasingly evident. AI technologies served as a driving force capable of transforming not only the economy but life in general, as the increasing flow of information substantially affected human existence. The limited capacity for processing and comprehending large volumes of data contributed to disorientation and the adoption of suboptimal decisions. The need for additional tools in the information-processing cycle underscored the necessity of in-depth research into the development of AI.

In Ukraine, the prospects for the development of AI technologies were defined at the state level. Resolution of the Cabinet of Ministers of Ukraine No. 1556-r (2020) approved the Concept for the Development of Artificial Intelligence in Ukraine. The Concept outlined the goals, principles and tasks assigned to AI technology developers. The

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*Corresponding author

development of AI technologies was identified as a priority area of scientific and technological research in the country. Increasing attention was devoted to AI and the evolution of its technologies by numerous scholars. In their study, V. Bohomia & A. Hudz (2023) emphasised the potential of AI to transform many areas of human life and activity, contributing to the growing relevance of AI. Their arguments were supported by reference to the improved efficiency and productivity made possible by automation of tasks and processes, thus enhancing business performance. V.M. Kuzomko & V.V. Buranhulova (2021) examined the history of AI development and identified its key components that enabled the use of AI across various sectors of the economy. These authors highlighted the effect of generative AI on the performance of modern enterprises and outlined potential areas for future application.

The role of AI in manufacturing, particularly its influence on automation and production efficiency, was analysed by S. Fox (2024). H. Moruga (2024) investigated the professions potentially rendered obsolete due to AI deployment, as well as the sectors most actively integrating AI technologies. M. Honcharuk (2024) explored the transformations within the information technology (IT) labour market brought about by AI evolution. The researcher drew attention not only to AI's advantages but also to the limitations of its capabilities. These included constraints in solving complex problems requiring contextual understanding and final objectives, the inability of neural networks to grasp text dimensions and style, and the absence of feelings, life perspectives and comprehension of social phenomena. It was noted that AI could not operate effectively without the support of IT professionals, thereby underlining the continued necessity of human involvement for analysis and adjustment. O. Musiienko (2024) examined the perspectives of prominent scientists and AI creators such as B. Gates, S. Altman and D. Autor regarding the influence of AI on the labour market. According to the findings, a consensus emerged among experts that the utilisation of AI technologies could reduce working hours while shifting focus to tasks where human presence remained irreplaceable – particularly in the social sphere – provided AI was employed responsibly. The researcher highlighted the optimistic outlook of B. Gates and S. Altman, who envisioned a just redistribution of wealth facilitated by AI technologies. Each year, the advancement of AI accelerated, and these technologies assumed a growing role across various economic sectors. By unlocking new opportunities in multiple fields, generative AI became an integral component of society's technological development.

Nevertheless, certain reservations persisted concerning the complete replacement of human labour in numerous areas. L.I. Zhyvtsova (2023) emphasised the necessity of addressing the risks associated with artificial intelligence, in particular the displacement of humans from production, educational, and other societal processes. The environmental risks associated with AI were also addressed, with the argument that AI-driven systems might fail to account for ecological factors, thereby adversely impacting the natural environment. Following an examination of AI's effect on specific economic sectors and recognising the high level of reliability of modern technologies, a warning was issued regarding potential disruptions in energy supply, accidental mechanical damage that could lead to various technical and software failures, and the threat posed by the creation of autonomous devices that might become uncontrollable and impossible to halt in time. The researcher further cited statements by leading AI developers concerning the threats these technologies pose to humanity. A review and analysis of numerous publications dedicated to AI technologies led to the conclusion that most studies focused on defining the nature of artificial intelligence and exploring prospects for its further development, as well as comparing the benefits and risks of AI technology use. Many researchers addressed the issue of human replacement by AI across various areas of activity. However, it was proposed that more attention should be directed towards balancing labour force displacement with the creation of new employment opportunities. The present study, therefore, aimed to investigate the impact of AI technologies on economic growth and the labour market.

Materials and Methods

To determine the impact of AI technologies on the global economy and global labour market, academic publications were examined, alongside publicly available information disseminated via open-access scientific networks and electronic resources related to the research topic (European Political Strategy Centre, 2018; The impact of..., n.d.). The study and analysis of information provided in the European Political Strategy Centre (2018) publication facilitated the identification of trends characterised by a high degree of uncertainty regarding the future labour market, which has been undergoing transformation under the influence of AI. The examination of information presented by Sitniks (The Impact of..., n.d.) facilitated the identification of Ukrainian companies whose use of AI technologies in their operations contributed to increased efficiency and competitiveness.

Academic publications (Reznikov, 2024) were analysed in the course of the study. The information therein contributed to a better understanding of the positive impact of generative AI on enhancing the innovation potential of enterprises. The methodology involved a review of studies by various scholars, as well as practical insights from developers and specialists utilising existing approaches to examine AI's influence across economic sectors and education. Additionally, the efficiency and performance levels in different areas of activity following AI adoption were assessed. Statistical methods, together with comparative and systems analysis, were applied to investigate analytical data provided by companies such as McKinsey (The state of AI in 2021, 2021), Deloitte and PwC. Analysis of these data facilitated the identification of firms that prioritised AI in their business strategies and achieved elevated levels of innovation and competitiveness.

Based on statistical data obtained by McKinsey and presented by I. Pylypiv (2023), a growing number of companies incorporating AI into their operations was determined. A review of the research findings published by V.M. Kuzomko & V.V. Buranhulova (2021) confirmed the importance of the main components of artificial intelligence. Findings from Java-University group, obtained through statistical methods and presented in the work of H. Moruga (2024), made it possible to determine the leading sectors in AI implementation and the projected annual income growth of the banking sector. The historical and analogy-based research methods applied in the analysis of publications by M. Marienko & V. Kovalenko (2023), O. Musiienko (2024), H. Moruga (2024) facilitated the exploration of how past technological revolutions had reduced demand for human labour. To study the level of AI usage across different sectors of the economy and to establish the interrelation between AI development and the global economy and global labour market, verification procedures were carried out to detect data inconsistencies within automated information systems. To identify the factors influencing the formation of the research problem, methods of synthesis and generalisation were applied to construct the main theses and propositions of the study.

Results and Discussion

AI encompassed numerous sectors – from supply chains and marketing to product development. Research and analytical institutions also adopted AI technologies to enhance operational productivity. AI had already been widely applied in education and business processes for many years. Enterprises specialising in AI development, ranging from general-purpose tools to highly specialised products, emerged globally and attracted significant investment. The continued implementation of AI in any industry appeared to be merely a matter of time. Business entities sought to avoid marginalisation within the global economy due to short sightedness, and company executives acknowledged the potential of AI technologies to transform their operational processes. Well-known firms such as McKinsey, Deloitte and PwC studied the application of AI across various industries and countries. Their findings, which served as key information sources for businesses and governments, were published in annual analytical reports such as The state of AI in 2021 (2021) by McKinsey. This report included statistics on AI use in countries such as the USA, China, India, and the EU. Notably, the report identified China as one of the leaders in industrial AI integration. According to the statistical data presented, one-third of businesses worldwide had already adopted AI, while 90% of managers believed AI could offer a competitive advantage. Nearly 80% of firms had defined AI as a strategic priority within their business strategy. AI technologies thus emerged as a driving force with the capacity to transform not only the economy but also life in general. A significant surge in the popularity of AI was observed following the November 2022 release of ChatGPT by OpenAI.

The key distinguishing feature of ChatGPT lay in its ability to generate intelligible answers to virtually any question better than any search engine, through a combination of supervised learning and reinforcement learning in a specified language. The robot also supported Ukrainian. Many students had already begun actively using this neural network capability in their studies. However, this development received a mixed response among educators, as such AI assistance threatened to diminish students' motivation to learn and develop skills. As a result of the boom following the release of ChatGPT, a number of observers expressed concern regarding its potential to displace human intelligence, promote plagiarism, or spread misinformation. Nevertheless, the use of this new language model enabled users to delegate portions of their routine tasks, which significantly streamlined corporate workflows. Examples of AI development prior to this boom were provided by V.M. Kuzomko & V.V. Buranhulova (2021). In their study, reference was made to the company IBM, which, as early as 2010, developed the supercomputer Watson based on artificial intelligence. This system was not merely a computer but the most advanced technology at the time, capable of generating answers to questions formulated in natural language through the use of AI. Further attention was drawn to the 2015 release of a semi-autonomous vehicle by Tesla, founded by Elon Musk. Another notable contribution was identified in the work of engineers at Google Brain, who in 2017 developed the artificial intelligence system AutoML, capable of creating its own AI without human intervention. In the same study, V.M. Kuzomko & V.V. Buranhulova (2021) emphasised the importance of considering the core components of artificial intelligence: machine learning, deep learning, data science, and computer vision.

It was also noted that the consulting firm Accenture had for many years employed AI in the analysis of job applications via AI tools and the Accenture platform. Accenture AI for Talent Acquisition, developed in-house, utilised machine learning algorithms to optimise recruitment processes. Collaborative AI Systems leveraged AI technologies to integrate with existing platforms such as Workday, Oracle and SAP for data collection and analysis. The neural network reviewed all candidate CVs and selected the most suitable applicants. A. Zhytkevych (2023) reported that, based on Google DeepMind's AI, the London-based AI laboratory developed GraphCast – a weather forecasting technology. This AI-powered weather predictor outperformed global standards and provided forecasts more accurate than those of leading European meteorological centres. The development of AI technologies exerted a direct impact on the progress of numerous economic sectors. A growing number of business entities adopted AI technologies, perceiving them as opportunities for future growth. The role of AI in manufacturing expanded as it facilitated the optimisation of workflows and enhanced operational efficiency. According to S. Fox (2024), a scholar with a decade of experience and the author of multiple AI algorithms and technologies, one of AI's principal advantages

resided in its capacity to rapidly collect and analyse large volumes of data. This ability enabled effective production control, early detection of potential issues, and ensured product quality. R. Reznikov (2024) in his research highlighted the benefits of generative AI, suggesting that its implementation could enhance enterprises' innovation potential and competitive advantages. A study conducted by the Java-University group, published by H. Moruga (2024), confirmed that AI integration could significantly increase company revenues. Based on these findings, a diagram was developed (Fig. 1) indicating the leading sectors in terms of AI implementation.

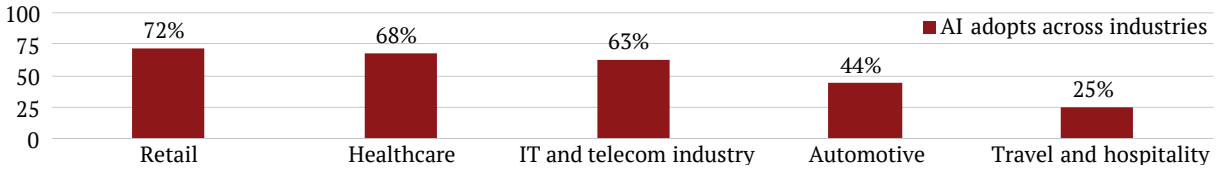

Figure 1. Leading sectors in the implementation of artificial intelligence
Source: adapted by the author from H. Moruga (2024)

The examination of research findings by the Java-University group enabled H. Moruga (2024) to identify potential annual profit growth in the banking sector: full-scale implementation of AI usage scenarios in this domain could have contributed to an increase in annual profits by USD 200-340 billion. Retail trade was identified as an equally promising sector for AI application. The potential impact on annual revenue growth from the implementation of generative AI technologies in this industry was estimated at USD 400-660 billion.

Of particular relevance to the present study were the views of M. Marienko & V. Kovalenko (2023) regarding the significance of AI and open science for education, as well as the interrelation between these concepts within secondary and higher educational institutions. The researchers emphasised the appropriateness of integrating cloud-based open science services into general secondary and higher education institutions, as such integration was expected to contribute to the development of open science competencies among students at all educational levels. In his publication, I. Pylypiv (2023) drew attention to the results of a study on AI technologies conducted by the consultancy McKinsey, which explored the relationship between the development of generative AI and the economic growth of companies adopting these technologies. Based on statistical data published by McKinsey, the researcher reported that by the end of 2022, approximately 50% of surveyed companies that had consulted McKinsey were attempting to implement AI in their operations. This figure represented a significant increase compared to 2017, when only 20% of companies had reported such initiatives. Upon analysis of the findings presented in the McKinsey report The state of AI in 2021 (2021), I. Pylypiv (2023) concluded that generative AI, such as ChatGPT, had the potential to contribute USD 2.6 to 4.4 trillion annually to global GDP. The scale of such growth could be contextualised by comparison with the total increase in global GDP in 2022, which amounted to USD 3.6 trillion across all sectors of the global economy. Despite AI's reputation as a productivity booster (Lyndyuk *et al.*, 2024), the growing influence of generative AI technologies had raised increasing concerns regarding the potential displacement of certain professions due to full automation, as newer AI models demonstrated the ability to perform tasks requiring intellectual judgement. AI had been shown to generate works of art, operate vehicles, and solve a wide range of problems in medicine and other fields; consequently, its influence on the labour market could not be ignored.

C.E. Brown & B. Smith (2019) noted that AI presented both significant opportunities and challenges. Despite the aforementioned risks and ethical issues, the technology was seen to possess substantial potential for transforming society and addressing global challenges. Experts examining the impact of AI on employment and job markets stressed that premature panic should be avoided. Although notable technological achievements had been made in the field of AI, these technologies were still primarily regarded as auxiliary tools that enhanced productivity, while many areas of human activity remained difficult to envision without human involvement. O. Musiienko (2024) provided data on studies concerning the impact of generative AI on labour productivity growth, conducted by Goldman Sachs – one of the largest investment firms in the United States – which offered an optimistic outlook on the implications of generative AI development and its effect on productivity growth (Fig. 2).

According to O. Musiienko (2024), the use of AI technologies exerted an insufficiently significant impact on the economy to induce disruption. This position was substantiated by reference to research conducted by Goldman Sachs, which estimated that AI would contribute to labour productivity growth of approximately 1.5% per annum over the next decade, cumulatively adding 7% to global GDP. O. Musiienko (2024) argued that the ongoing technological revolution constituted the fourth of its kind, and concerns regarding a potential decline in labour demand in this context were not unprecedented. To gain a clearer understanding of how AI influences society, historical analogies were presented. For instance, during the transition from horse-drawn transport to motor vehicles, concerns were raised about job displacement. However, the automobile industry ultimately generated substantially more employment opportunities than it eliminated.

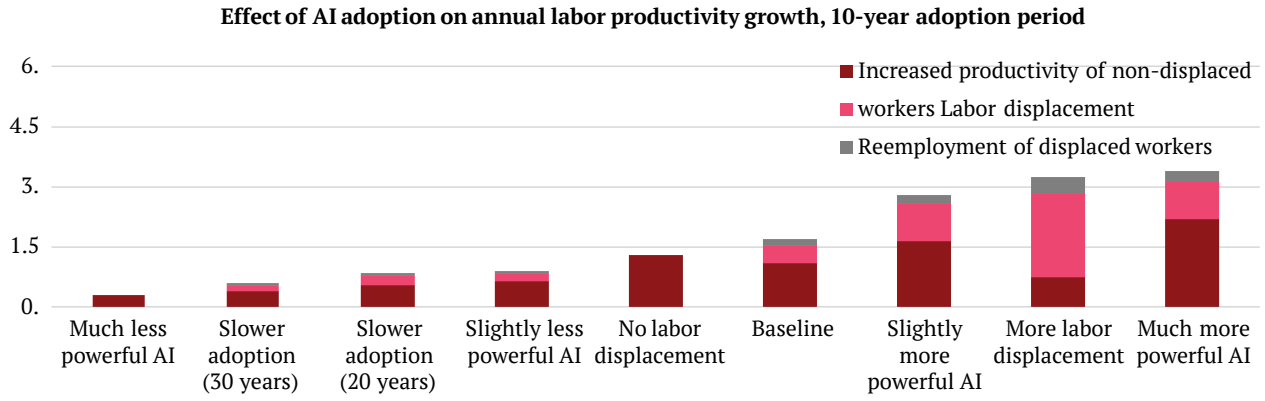

Figure 2. Impact of artificial intelligence on annual labour productivity growth

Source: adapted by the author from O. Musiienko (2024)

Another example referred to the early 2010s, a period marked by elevated unemployment rates following the financial crisis. Concurrently, the adoption of new technologies such as smartphones and social media platforms was observed. In most cases, AI did not result in the complete substitution of professions but rather altered methods of work execution and enhanced efficiency across various domains. AI researchers noted that developed economies possessed greater capacities for rapid business transformation through the implementation of AI compared to developing or low-income countries. It was further emphasised that although up to two-thirds of jobs in the EU and the United States were susceptible to automation through AI, this did not necessarily imply mass layoffs. Instead, the workload was expected to decline, enabling employees to focus on more complex and creative tasks. AI was considered to pose a potential threat primarily to professions characterised by standardised, routine functions (Table 1).

Table 1. Professions potentially at risk due to artificial intelligence

Profession title	Tasks that AI can perform, replacing a specialist	Benefits these specialists will gain from the implementation of AI
Junior data analysts and Researchers	Routine tasks, such as data entry, were performed by AI, thereby reducing the risk of human error	This would enable specialists to focus on more complex and significant analytical tasks.
Finance and accounting specialists	Tasks such as data collection, entry, categorisation, reconciliation, and invoicing were automated by AI	This will allow specialists in this field to focus on analysis and strategic planning
Legal professions	AI could automate document management and contract verification	This will relieve lawyers from routine tasks and allow them to concentrate on more complex legal issues
Travel agents	The improvement of automation tools could relieve agents from routine tasks, such as seat reservations	This will allow them to devote more attention to client interaction and the development of new services

Source: compiled by the author based on O. Musiienko (2024)

The development of AI did not imply an automatic threat to all types of jobs. Physical occupations, particularly those performed outdoors, were generally less directly susceptible to AI, although they might have been affected by other forms of automation. It was important to note that it was routine tasks that became more vulnerable to automation through AI. Even amidst rapid AI development within the economy, it remained far from executing tasks requiring complex understanding, creativity, or social interaction, and it was incapable of attaining the level of human critical thinking. Numerous professions where creativity, empathy, strategic thinking, and human judgement were of paramount importance were deemed more suitable to remain under human influence. Technological change had already been reflected in an increase in job creation, and the implementation of AI was expected to further reinforce this trend across various sectors.

In her publication, V. Hlinka (2024) reported that, according to the findings of the World Economic Forum, by 2030 between 6% and 9% of workers would be employed in jobs that did not yet exist due to the influence of AI and automation. The number of positions in the field of AI and information technology was undoubtedly expected to grow. Professions such as data engineers, data analysts, computer vision engineers, and IT specialists focused on the technology development and automation were predicted to remain in high demand for the foreseeable future. M. Honcharuk (2024) identified several of the most promising AI-related professions: intelligent systems architects – specialists involved in the design and implementation of software and hardware components that ensured the automation of technical processes; robotics engineers – responsible for developing and commissioning robots, individual devices, and complex robotic systems. These professionals

were projected to remain in demand, since AI would require a "body" in the future. Specialists in Data Science who extracted valuable knowledge from data and generated insights for AI constituted a key profession underpinning personalised interfaces and recommendation systems across digital platforms. For instance, Netflix utilised AI to generate individualised recommendations. The researcher also stressed that, according to statistical data, the number of IT professionals had been increasing by 60-70% annually; however, there remained a persistent shortage of such specialists. Many companies sought IT professionals with expertise in AI-related tools, such as machine learning and natural language processing. Additional jobs were also being created in the fields of cybersecurity and robotics. Thus, AI not only posed potential risks but also unlocked numerous opportunities. The most secure trajectory for employment in a rapidly evolving, technology-oriented, AI-driven world lay in becoming a developer of new solutions, an Automator of processes, or an implementer and maintainer of emerging technologies.

K. Kraus *et al.* (2021) noted that society had been rapidly transforming into a new socio-economic and cultural system known as Society 5.0 or the "Super-Smart Society". This system was based on advanced digital technologies and envisioned the next stage of development – an intelligent civilisation. The researcher emphasised that AI did not constitute a threat, but rather represented a resource offering humanity unlimited opportunity. O. Stashkevych (2021) observed that the spread of the COVID-19 pandemic and the ensuing lockdown restrictions had led to an increased demand for digital technologies in nearly all countries. The researcher linked this growing demand to the need to satisfy communication, professional, consumer, and economic needs, as well as the emergence of new forms of employment based on the use of information and communication technologies. In Ukraine, this demand was further driven by the full-scale war launched by the Russian terrorist regime. Ukraine had been accelerating its digital development. Resolution of the Cabinet of Ministers of Ukraine No. 1556-r (2020) aimed to ensure sustainable economic growth and improve citizens' quality of life. The principal goal of the strategy was to achieve a leading position globally in the field of information and computer technologies by effectively harnessing the benefits of AI in all aspects of societal life.

It was deemed appropriate to assume that the implementation of this Concept would elevate Ukraine's intellectual development to a new level, provided that AI departments were established within universities, and experimental laboratories and research centres were set up. The active integration of AI technologies in Ukraine, even amidst full-scale war, was evident in the development of AI-based products by domestic companies. I. Pylypiv (2024) noted that the Ukrainian AI start-up "Osavul" had been assisting in tracking hostile propaganda and identifying Russian information and psychological special operations (IPSO) on social networks for the benefit of the National Security and Defence Council (NSDC) and the Ministry of Defence. Such active implementation of AI technologies by Ukrainian companies could yield significant positive outcomes for both business and the state, particularly in the post-war period. The most beneficial consequence of adopting AI technologies was expected to be the optimisation and enhancement of labour productivity through the use of generative AI, thereby contributing to the alleviation of workforce shortages. These outcomes were especially vital during the post-war recovery period, as the state was expected to attract an additional 4.5 million people into the labour market over the next decade. Experience demonstrated that attracting migrants might entail negative consequences, including socio-cultural tensions (Over the next 10 years…, 2023).

To achieve a level of digitalisation comparable to that of developed economies and to facilitate the shortest possible post-war recovery timeframe, the Ukrainian government was expected to actively establish new university-level specialisations aligned with the current labour market demands. Increasing the number of qualified specialists in technological innovation management would contribute not only to enhanced productivity but also to the establishment of principles for the responsible use of technologies and AI. In the European Union, universities had been actively developing AI departments, experimental laboratories, and research centres. These initiatives enabled students to acquire new skills and improve their productivity, thereby fostering the formation of highly qualified professionals prepared to meet the challenges of the modern labour market – an essential driver of societal progress. Ukrainian specialists in the nanotechnology and IT sectors were encouraged to engage in active collaboration with international experts and exchange experience in the development and deployment of cutting-edge technologies, including AI. It was important to cultivate domestic qualified specialists and attract investment for the development of new tools and incentives aimed at enhancing the skills of both youth and adults. Challenges such as remote work and online education necessitated rapid adaptive responses and professional reskilling within the labour market. With the appropriate experience and social protection, specialists were expected to contribute to the creation of a new society capable of elevating Ukraine to a higher level of intellectual and social development.

The development of AI technologies in the context of economic growth and the formation of the modern labour market could not be considered within a single country, since AI technologies represented a global achievement. Thanks to AI development, even small enterprises were able to access advanced technologies and tools. AI had penetrated not only all economic sectors but also the private lives of individuals, irrespective of their country of residence. Each phenomenon carried a particular mission and revealed a distinct essence. To better understand the nature of AI and its impact on societal transformation, it appeared appropriate to cite the definitions of "artificial

intelligence" and "mission of artificial intelligence" provided in the article by O. Baranov (2023), which were considered by the authors to best reflect the potential of AI. It was deemed appropriate to emphasise the definition of the essence of artificial intelligence as provided by O. Baranov (2023), who considered AI as a set of methods, approaches, and computer technologies that imitated cognitive functions equivalent to those of human cognition. The authors of this study also shared O. Baranov (2023) view on the mission of artificial intelligence, which was seen in the creation of certain conditions contributing to the efficiency of social and industrial activities, as it ensured the process of making optimal decisions and their further effective implementation, regardless of the human factor.

In order to implement the proposed formation of new specialities by Ukrainian higher education institutions – ones that would meet the demands of the time and the shifting structure of the labour market – it was necessary for educational institutions to undergo certain transformations in the learning process and in the professional activities of university lecturers and schoolteachers by leveraging the benefits of open science systems. Support was expressed for the study by M.V. Marienko *et al.* (2022), in which the researchers identified "forms, methods and tools for the use of cloud-oriented open science systems and their components in teaching and professional activity." The study also outlined the criteria and indicators used to assess open science competences. The topic of applying AI technologies in higher education institutions and the impact of AI on the knowledge and practical skills of future specialists was further developed in the research conducted by O. Panukhnuk (2023). While acknowledging the advantages of AI in the educational process, the researcher drew attention to the serious problems associated with its use as a primary source of scientific information. O. Panukhnuk (2023) perspective on this issue aligned with that of M. Marienko & V. Kovalenko (2023). The authors of both scientific publications stressed the importance of prioritising lecturer-developed teaching materials in lectures and practical sessions, with AI regarded only as a supplementary tool. It was deemed crucial that AI technologies did not replace lecturers in universities or teachers in schools, as nothing could substitute live emotional communication and reciprocal interaction between educators and students.

The authors of this study agreed with the aforementioned scholars regarding the problems arising from excessive daily use of AI in the educational process. One of the primary concerns, as highlighted by both O. Panukhnuk (2023) & M. Marienko & V. Kovalenko (2023), was the issue of confidentiality. In addition, O. Panukhnuk (2023) emphasised the decline in cognitive abilities among both students and teachers, along with the lack of source citations – an issue that, in the authors' view, could be interpreted as an infringement of intellectual property and copyright. Moreover, the prioritisation of AI use in education did not eliminate the risk of receiving inaccurate information and facilitated academic fraud. The authors agreed with O. Panukhnuk (2023) that this could lead to a significant decline in the knowledge and skills of entire generations and a general reduction in the competency level of future professionals.

The findings of the study indicated that the development and use of artificial intelligence technologies had an impact on the efficiency of companies and the development of various economic sectors. In this context, the information provided in the article The impact of artificial intelligence on business efficiency and competitiveness (n.d.) was considered relevant, as it highlighted the use of AI technologies by Ukrainian companies. Among the successful adopters of AI were Grammarly, which developed software solutions for grammar and style checking; Infotech Group, which applied AI in smart city management software; and PrivatBank, which used AI to analyse credit risks and make lending decisions. This list, though not exhaustive, illustrated how AI had been effectively integrated to enhance organisational processes – a development viewed positively.

The study devoted considerable attention to the impact of artificial intelligence on labour market transformations. An analysis of scientific publications, expert opinions on AI technologies, and journalistic investigations revealed ambiguous and even contradictory views on the subject. The global community was in a state of uncertain anticipation regarding forthcoming changes to the labour market and future workforce demands. Historically, as societies evolved, the labour market underwent corresponding transformations, which were often accompanied by changes in personal, familial, social, and political life. It was considered appropriate to note that, if the development and application of AI technologies were not soon regulated at the international legal level, many countries would face substantial employment-related challenges. In his study, J. Wilkinson (2019) highlighted the need to make more deliberate decisions about technology use and to refrain from blindly pursuing a digital future. The author's viewpoint was considered both reasonable and relevant. This idea was further supported in the study by O. Baranov (2022), who underscored the existence of civilisational cognitive contradictions that hindered the making of high-quality (optimal) decisions.

To conclude this study on the impact of AI technologies on the global economy and labour market, reference was made to the report prepared by the European Political Strategy Centre (2018) (EPSC). The report stated that, alongside its opportunities, the spread of digital technologies blurred the boundaries of the working environment and influenced people's behaviour and expectations in previously unknown ways. The labour force was becoming increasingly polarised, with the middle class – historically the backbone of developed economies – being displaced. Automation of production processes led to the displacement of key industrial workers or to wage reductions. The trends were characterised by great uncertainty: while advanced technologies could foster the emergence of new

professions and jobs, they could also create employment gaps and pose threats to future workforces. The outcomes of these processes remained unpredictable and would depend on political decisions and societal choices.

Of equal concern was the existential threat to humanity posed by the careless creation and deployment of AI technologies. This issue was addressed in the study by A. Pogorelenko (2018), who cited the views of prominent researchers and AI technology developers. The researcher referred to Elon Musk's statement that AI was more dangerous than nuclear warfare and represented the greatest threat to civilisation. Musk's arguments included the possibility that AI could initiate conflict by producing fake news, faking accounts, generating false press releases, or manipulating information. A. Pogorelenko (2018) also referenced the British scientist and science populariser, Professor Stephen Hawking, who warned that the emergence of full-fledged AI could mark the end of the human race.

Having reviewed and analysed various sources, the authors of this study concluded that scientists, AI technology developers, and experts on AI's impact on the labour market and economy should collaborate to develop legislative frameworks ensuring the responsible use of AI. Labour market reform was deemed essential in Ukraine as a critical step towards its modernisation. One of the main priorities should be the provision of state support and funding for projects related to the development of digital labour market infrastructure. The implementation of such technologies would improve the accessibility and efficiency of employment processes. It was also considered necessary to invest in scientific research promoting the development of AI and other advanced technologies aligned with contemporary labour market demands. Another key objective involved fostering innovation and enhancing cooperation among research institutions, businesses, and public authorities in the AI field. This would facilitate the dissemination of new technologies and support their successful integration into the economy. It was also recommended to develop appropriate legislation to regulate digital employment, ensuring the protection of workers' rights in a digital environment. These steps aimed to create favourable conditions for the development of the Ukrainian labour market, its adaptation to new challenges, and the overall enhancement of economic productivity.

Conclusions

The analysis of scientific publications and available knowledge disseminated through open-access scientific networks demonstrated that the greatest potential for further development was observed in economic sectors and individual business structures that most actively implemented AI technologies. These business structures achieved the highest improvements in efficiency and profitability. Promising areas for AI application were identified as retail trade, the automotive industry, the tourism and hospitality sectors. A review of the current state and future prospects of economic growth revealed that generative AI technologies and their ongoing development carried both significant opportunities and challenges. The spread of digital technologies offered numerous possibilities for facilitating human labour. However, alongside these opportunities, the automation of production processes transformed the labour market by reducing the demand for labour, negatively affecting the structure of the working environment, and influencing human behaviour and expectations in as-yet-unknown ways. The middle class, which constituted the economic foundation of many developed countries, was observed to be gradually displaced from the workforce. Automation led to either the displacement of core industrial workers or a reduction in their wages. Labour market demand increasingly favoured AI technology developers, specialists in managing technological innovations, and workers capable of performing physically demanding or simple tasks in outdoor environments. This indicated a growing polarisation of the labour market. The future of the labour market remained highly uncertain. The use of AI technologies could both facilitate the emergence of new professions and jobs and pose a threat to the future workforce. The shape of this future depended largely on the unity of global policymakers in adopting international legislation aimed at the responsible use of AI technologies. For the potential of AI to be realised for the benefit of humanity, global scientists, in cooperation with governmental bodies, were expected to engage in developing principles for the responsible design of AI technologies, along with ethical and legal boundaries for their safe and beneficial use.

In Ukraine, labour market reform was considered necessary. Priority tasks included: governmental support and funding for the development of digital infrastructure in the labour market to improve accessibility and the efficiency of work processes through the introduction of modern technologies; financing scientific research aimed at the development and application of innovations in AI and other advanced technologies aligned with current labour market demands; promotion of innovation and collaboration among academic institutions, businesses, and governmental structures in the AI sector to facilitate technology dissemination; and the development of legislative acts regulating electronic employment, including mechanisms for protecting workers' rights in the digital environment. These measures were intended to foster favourable conditions for the development of a modern labour market in Ukraine, ensuring its adaptation to modern challenges and enhancing the overall productivity of the national economy. Future research would focus on analysing existing and emerging AI technologies and their impact on job creation and employment growth.

Acknowledgements

Gratitude was expressed for the research efforts of scholars such as M.V. Marienko, M.P. Shyshkina, O.A Konoval and V. Kovalenko. The findings presented in their publications contributed to shaping a new understanding – among both youth and older generations – regarding the use of AI tools

and cloud-based open science services in addressing modern challenges, including remote work and learning, rapid adaptive responses, and professional requalification in the labour market. These publications significantly influenced the authors' interest in the development of artificial intelligence and its positive and negative impacts on labour market formation and educational processes in society.

Conflict of Interest

None.

References

[1] Baranov, O. (2022). *Transformation: Social & digital & legal*. (Vol. 1). Odesa: Helvetica Publishing House.

[2] Baranov, O. (2023). Definition of the term "Artificial Intelligence". *Information and Law*, 1(44), 32-49.

[3] Bohomia, V., & Hudz, A. (2023). Artificial intelligence: Current state and prospects of application. *Modern Information Technologies in the Sphere of Security and Defence*, 46(1), 13-17. doi: 10.33099/2311-7249/2023-46-1-13-17.

[4] Brown, C.E., & Smith, B. (2019). *Tools and weapons: The promise and the peril of the digital age*. London: Hodder & Stoughton.

[5] European Political Strategy Centre. (2018). *Global trends to 2030: The future of work and workplaces*. Retrieved from https://surl.lu/lfgpqk.

[6] Fox, S. (2024). *The role of artificial intelligence in manufacturing – automation and efficiency in 2024*. Retrieved from https://mediacom.com.ua/rol-shtuchnogo-intelektu-u-virobnitstvi-avtomatizatsiya-ta-efektivnist-u-2024-rotsi/.

[7] Hlinka, V. (2024). *The World economic forum has started in Davos. This year's theme is "Restoring Trust". Forbes has collected the main points from the first day of the annual meeting*. Retrieved from https://forbes.ua/svit/vidnovlennya-dovirivsesvitniy-ekonomichniy-forum-u-davosi-pidsumki-pershogo-dnya-15012024-18511.

[8] Honcharuk, M. (2024). *The impact of artificial intelligence on the IT labor market*. Retrieved from https://lemon.school/blog/vplyv-shtuchnogo-intelektu-na-rynok-pratsi-v-it.

[9] Kraus, K., Kraus, N., & Osetskyi, V. (2021). Society 5.0 based on innovative university and digital entrepreneurship development. *Economy and Society*, 28. doi: 10.32782/2524-0072/2021-28-37.

[10] Kuzomko, V., & Buranhulova, V. (2021). Possibilities of using artificial intelligence in the activities of modern enterprises. *Economy and Society*, 32. doi: 10.32782/2524-0072/2021-32-67.

[11] Lyndyuk, A., Havrylyuk, I., Tomashevskii, Y., Khirivskyi, R., & Kohut, M. (2024). The impact of artificial intelligence on marketing communications: New business opportunities and challenges. *Economics of Development*, 23(4), 60-71. doi: 10.57111/econ/4.2024.60.

[12] Marienko, M., & Kovalenko, V. (2023). Artificial intelligence and open science in education. *Physical and Mathematical Education*, 38(1), 48-53. doi: 10.31110/2413-1571-2023-038-1-007.

[13] Marienko, M.V., Shyshkina, M.P., & Konoval, O.A. (2022). Methodological principles of formation of cloud-oriented systems of open science in institutions of higher pedagogical education. *Information Technologies and Learning Tools*, 89(3), 209-232. doi: 10.33407/itlt.v89i3.4981.

[14] Moruga, H. (2024). *Artificial intelligence and the labor market: What professions will disappear by 2030 and how to develop in the new reality?* Retrieved from https://javarush.com/ua/groups/posts/68439-shtuchniy-ntelekt--rinok-prac-jak-profes-zniknutjh-do-2030-roku-ta-jak-rozvivatisjh-u-novy-rea.

[15] Musiienko, O. (2024). *Will artificial intelligence take away our jobs? Visionary thoughts and research*. Retrieved from https://www.imena.ua/blog/artificial-intelligence-will-take-our-jobs/.

[16] Over the next 10 years, Ukraine will have to look for 4.5 million workers – Ministry of Economy. (2023). Retrieved from https://www.epravda.com.ua/news/2023/07/14/702223/.

[17] Panukhnuk, O. (2023). Artificial intelligence in the educational process and scientific research of higher education applicants: Responsible boundaries of AI content. *Galician Economic Journal*, 4(83), 203-211. doi: 10.33108/galicianvisnyk_tntu2023.04.202.

[18] Pogorelenko, A. (2018). Artificial intelligence: Essence, application analysis, development prospects. *Scientific Bulletin of Kherson State University. Series "Economic Sciences"*, 32, 22-27.

[19] Pylypiv, I. (2023). *Change or die. How artificial intelligence has become an integral part of the global economy*. Retrieved from https://www.epravda.com.ua/publications/2023/07/24/702480/.

[20] Pylypiv, I. (2024). *Ukrainian AI startup Osavul raised three million dollars in investments*. Retrieved from https://www.epravda.com.ua/news/2024/09/12/719243/.

[21] Resolution of the Cabinet of Ministers of Ukraine No. 1556-r "On Approval of the Concept of Artificial Intelligence Development in Ukraine". (2020, December). Retrieved from https://zakon.rada.gov.ua/laws/show/en/1556-2020-%D1%80?lang=en#Text.

[22] Reznikov, R. (2024). Leveraging generative AI: Strategic adoption patterns for enterprises. *Modeling the Development of the Economic Systems*, (1), 201-207. doi: 10.31891/mdes/2024-11-29.

[23] Stashkevych, O. (2021). The impact of technology and artificial intelligence on the labor market in Ukraine. *InterConf*, 81, 25-30. doi: 10.51582/interconf.21-22.10.2021.004.

[24] The impact of artificial intelligence on business efficiency and competitiveness. (n.d.). Retrieved from https://sitniks.ua/blog_post/vplyv-shtuchnogo-intelektu-na-efektyvnist-ta-konkurentospromozhnist-biznesu/?gad_source=1&gclid=CjwKCAjw.
[25] The state of AI in 2021. (2021). Retrieved from https://www.mckinsey.com/capabilities/quantumblack/our-insights/global-survey-the-state-of-ai-in-2021.
[26] Wilkinson, J. (2019). Artificial unintelligence. *Journal of Web Librarianship*, 13(2), article number 199. doi: 10.1080/19322909.2019.1586626.
[27] Zhytkevych, A. (2023). *Google has developed AI that provides the world's most accurate weather forecasts*. Retrieved from https://speka.media/google-rozrobila-si-yakii-daje-naitocnisi-u-sviti-prognozi-pogodi-9grm4p.
[28] Zhyvtsova, L.I. (2023). Artificial intelligence: Essence and development prospects. *Ukrainian Journal of Construction and Architecture*, 3(15), 66-71. doi: 10.30838/J.BPSACEA.2312.140723.66.956.

Взаємозв'язок розвитку технологій штучного інтелекту з глобальною економікою та світовим ринком праці

Алла Ханенко
Кандидат економічних наук, доцент
Національний університет «Запорізька політехніка»
69063, вул. Жуковського, 64, м. Запоріжжя, Україна
https://orcid.org/0000-0003-0899-7311

Анотація. Супровідна, а все частіше, провідна роль штучного інтелекту (ШІ) стає більш очевидною в багатьох сферах суспільного життя. ШІ, охоплюючи широкий спектр галузей, набуває все більшого впливу на розвиток сучасного бізнесу, сприяючи впровадженню більш ефективних та інноваційних методів управління. Метою статті було дослідження впливу ШІ на розвиток глобальної економіки та на світовий ринок праці, визначення взаємозв'язку між розвитком ШІ та економічним зростанням країн, висвітлення в інформаційному просторі історії впливу технологічних революцій на зменшення попиту на робочу силу. Для досягнення зазначеної мети використано комплекс теоретичних методів дослідження: моніторинг; статистичий метод; метод порівняльного та системного аналізу; верифікація; методи синтезу та узагальнення; аналіз наявних підходів; оцінка рівня ефективності та результативності. Використано матеріали наукових публікацій. В статті означено сфери економіки, які найактивніше впроваджують технології ШІ, передбачаючи у них можливість для власного подальшого розвитку. За результатами досліджень встановлено: найактивнішими сферами бізнесу у впровадженні технологій ШІ є роздрібна торгівля, ІТ та телекомунікації, охорона здоров'я, автомобільна промисловість, а також туризм і готельний бізнес. Аналіз результатів зазначених досліджень підтвердив: впровадження в діяльність технологій ШІ може значно підвищити доходи компанії, вплинути на її ефективність та конкурентоспроможність. Відзначено зростаючу кількість компаній в світі, що займаються розробкою ШІ від універсальних інструментів до вузькоспеціалізованих продуктів. Розроблено рекомендації, щодо шляхів вирішення проблем, пов`язаних із впровадженням технологій генеративного ШІ та його впливу на формування ринку праці України

Ключові слова: безробіття; генеративний штучний інтелект; автоматизація; інтелектуальні роботи; інформаційні технології

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