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Контактна адреса:
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
E-mail: info@eem.com.ua
https://eem.com.ua/uk

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Address for contacts:
Lviv Polytechnic National University
79013, 12 Stepan Bandera Str., Lviv, Ukraine
E-mail: info@eem.com.ua
https://eem.com.ua/en

Editorial Board

ЗМІСТ/ CONTENTS

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Kateryna Kuznietsova*
PhD in Economics, Associate Professor
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"
03056, 37 Beresteyskyi Ave., Kyiv, Ukraine
https://orcid.org/0000-0003-0162-1071

Anna Omelchenko
PhD in Economics
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"
03056, 37 Beresteyskyi Ave., Kyiv, Ukraine
https://orcid.org/0000-0001-9376-7566

Oleksandr Chenusha
PhD in Economics
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"
03056, 37 Beresteyskyi Ave., Kyiv, Ukraine
https://orcid.org/0000-0001-7184-2705

Analysis of the European renewable energy market in the context of the decarbonisation trend

Abstract. This study aimed to identify the development trends of the renewable energy market in the European Union, with particular emphasis on its role in the decarbonisation of the energy sector. The study explores energy consumption patterns in the EU from 2000 to 2022 and analyses the contribution of renewable energy sources (RES) to the achievement of Sustainable Development Goals. A comparative analysis of the development of the renewable energy market and the energy systems of the EU and Ukraine is provided, taking into account Ukraine's trajectory towards European integration. Special attention is given to the imperative of the circular economy as a leading economic model. The impact of the circular economy on global economic development is identified, particularly in terms of reducing waste and dependency on energy imports. A statistical analysis of the EU's dependence on natural gas imports is conducted, along with an assessment of greenhouse gas emission reductions and the increasing share of RES in electricity generation. The findings indicate that the EU is actively addressing energy security challenges, notably through the expansion of wind and solar power while maintaining its global leadership in the energy transition. It was established that between 2005 and 2022, the share of RES in electricity generation within the European Union increased from 10.18% to 23.06%. Iceland and Norway emerged as leaders in this area due to their well-developed hydropower sectors. In 2023, the share of RES reached a historic high of 24.1%, contributing significantly to strengthening the EU's energy independence. The main drivers of this growth were the implementation of legal frameworks, notably the Fit for 55 package and the REPowerEU plan. The structure of energy consumption in the EU is also examined, with RES accounting for 18.4%, highlighting the importance of improving energy efficiency. Key achievements in the development of the renewable energy market in Ukraine are outlined, along with the current challenges and prospects, particularly in the context of integration into the European energy system through ENTSO-E. The analysis underscores the positive impact of RES on environmental sustainability and the competitiveness

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*Corresponding author

of both the EU and Ukrainian economies while also drawing attention to the need to overcome geographical and socio-economic barriers in the implementation of regulatory mechanisms and legal initiatives

Keywords: renewable energy; development trends; European energy space; energy system; circular economy; carbon neutrality; ESG principles

INTRODUCTION

The International Energy Agency suggests that European countries should aim to decarbonise their energy industries by 2035. This would help meet the goals of the Paris Agreement to limit global warming to 1.5°C. Research by the organisation Beyond Fossil Fuels indicates that the top 10 EU countries (which together make up over 60% of the EU's energy sector) have committed to phasing out fossil fuels by 2035 or earlier. Specifically, Austria, Denmark, Lithuania, and Luxembourg have announced plans to switch from coal and natural gas to RES. Belgium, France, Germany, Greece, Italy, and the Netherlands also intend to decarbonise their energy systems by 2035. The main renewable energy sources in a decarbonised European energy system are expected to be groundbased and rooftop solar power, as well as onshore and offshore wind power (Green Transformation of Ukraine, 2024).

The relevance of research into the use of renewable energy by countries worldwide and the decarbonisation of economies is clear not only from the actual trends in national economies and energy markets between 2000 and 2022 but also from the significant interest shown by economic researchers in these topics. L. Rimšaitė (2024) examines how the European energy market has developed and the difficulties in balancing the dynamics of a competitive market with regulatory goals (such as ensuring reliability, fairness, and sustainability). The research also looks at the potential for creating regulations that will encourage fair competition and achieve long-term policy aims in the energy sector. Energy security has historically been a crucial issue for EU countries, evolving alongside shifts in the geopolitical situation, economic pressures, and technological advancements. Ensuring a stable and varied supply of energy sources is fundamental to the socioeconomic stability of the region, especially given today's global challenges, namely instability in the energy market, geopolitical tensions, and climate change (Kosowski, 2024; Pang *et al*., 2024).

M. Song *et al*. (2022) developed a theoretical model to explain how the integration of the energy market is linked to the growth of RES. Using data from 20 EU countries between 2007 and 2019, they empirically tested the relationship between how integrated the energy market is and the development of RES. Their findings showed a significant positive impact of energy market integration on the growth of renewable energy. C. Veghes *et al*. (2024) assess the connections between the production, consumption, and share of RES. They also look at EU consumers' attitudes towards renewables and their willingness to see them as a reliable alternative to traditional energy sources, considering the economic, social, and environmental aspects of sustainable development in EU member states. Given the EU's increasing demands for a higher share of renewables in the energy, industrial, construction, and transport sectors, research is being conducted on the state of the renewable energy market in specific countries, such as Poland (Jaworski *et al*., 2023).

K. Constant *et al*. (2024) are researching how macroeconomic factors, particularly financial crises, affect the EU's renewable energy market. S. Soeiro & M. Ferreira Dias (2020) look at the social impact of introducing renewable energy. They point out that while there are environmental benefits, renewable energy projects do affect local communities. Therefore, national and local authorities need to make sure that citizens are involved in these projects to gain their support. J. Pedraza Morales (2024) highlights the significant progress the EU has made in its energy transition strategy, positioning itself as a global leader. However, they believe the EU needs to build a balanced energy system with a diverse mix of energy sources to ensure stability during crises. A comprehensive model for the development of global energy in the context of decarbonisation is being developed, which includes innovative areas such as small modular reactors (SMRs), large nuclear power plants, wind and solar energy, and the use of biofuels (Kharin *et al*., 2024).

This article aimed to analyse the European renewable energy market and its development trends in the context of the new global push for decarbonisation and Ukraine's move towards European integration. The main objectives of the research were to identify the key development trends in the EU's renewable energy market, compare the Ukrainian market with the EU market, and analyse how the renewable energy market is regulated in the EU and Ukraine in the context of the decarbonisation trend.

MATERIALS AND METHODS

In this research, a range of statistical information sources (Eurostat, n.d.; Sustainable Development Solutions Network, n.d.; European Environment Agency, 2025) and analytical articles by leading economic scholars, international organisations, and government bodies were analysed. The focus was on the European renewable energy market within the context of the trend towards economic decarbonisation. Methods of scientific inquiry, generalisation and systematisation, statistical analysis, and the identification of cause-and-effect relationships were employed.

A detailed analysis was conducted on the changes in energy consumption figures in the EU between 2000 and 2022. Key trends demonstrating the EU's path towards decarbonisation were identified. An analysis of the EU's reliance on natural gas imports from Russia was presented, using data from May 2021 to August 2024. The energy self-sufficiency of EU countries as of 2022 was determined. The achievements of the UN's Sustainable Development Goals by EU countries and Ukraine were compared for 2018 and 2024 based on data from J.D. Sachs *et al.* (2018) and J.D. Sachs *et al.* (2024).

The proportion of RES in the total electricity production in the EU was analysed for the period 2005-2022. Additionally, the share of RES in the EU's gross final energy consumption in 2022 was analysed by electricity generation type. The energy efficiency indicator used to monitor progress towards achieving the energy efficiency targets set out in Directive (EU) No. 2023/1791 (2023), was also examined.

Emphasis was placed on the introduction of the circular economy approach in the EU as a key direction for achieving Sustainable Development Goals, improving resource efficiency, and reducing dependence on imported primary energy sources. The main aspects of implementing a circular economy in the EU were identified. For comparison, the state of renewable energy market development in Ukraine and the implementation of circular economy principles in Ukraine were presented. Furthermore, an analysis was conducted on the directions of renewable energy market regulation in the EU and the main measures within these directions in the context of the decarbonisation trend. The direction of renewable energy market regulation in Ukraine and the prospects for development, considering current realities, were also determined.

RESULTS

Since 2022, the EU has successfully addressed key energy security challenges by regaining control over its energy market and prices and by accelerating its progress towards the climate neutrality set out in its Green Deal (Sustainable Development Solutions Network, n.d.). Renewable energy plays a crucial role in this process. The main trends demonstrating this path towards decarbonisation are as follows:

1) A record increase in the share of renewables – in the first half of 2024, half of the electricity generated in the EU came from renewable sources. The dynamics of energy consumption indicators in the EU from 2000 to 2022 are presented in Table 1.

2) A significant reduction in natural gas consumption – between August 2022 and May 2024, demand for natural gas fell by 138 billion m^3.

Table 1. Dynamics of energy consumption indicators in the EU, 2000-2022

Indicators	2000	2005	2010	2018	2022
Total energy supply, GWh, including:	17,091,252	18,289,837	17,765,554	16,643,604	15,346,580
– natural gas, GWh	3,588,988	4,183,440	4,219,855	3,777,913	3,421,444
– RES, GWh	1,120,695	1,394,672	2,023,648	2,625,174	2,898,030
Share of natural gas in total energy supply, %	21.00	22.87	23.75	22.70	22.29
Share of RES in total energy supply, %	6.56	11.06	11.39	15.77	18.88

Source: compiled by the authors based on the Eurostat (n.d.)

The total energy supply decreased by 10.21% from 2000 to 2022. Over the same period, natural gas consumption fell by 4.77%, although its share in overall consumption has remained relatively stable since 2005, accounting for 22.29% in 2022. Energy consumption from RES increased 2.59 times between 2000 and 2022, and the share of RES rose from 6.56% in 2000 to 18.88% in 2022. In 2024, RES provided 50% of electricity generation in the EU, while primary energy consumption has been declining since 2022 (down by 4.1%). Nevertheless, EU countries need to step up their efforts in energy efficiency to achieve the target of reducing energy consumption by 11.7% by 2030 (European Commission, 2024).

3) reduction in dependence on Russian natural gas – the share of imports decreased from 45% in 2021 to 18% in June 2024. The import of natural gas from the Russian Federation to the EU from May 2021 to August 2024 is shown in Figure 1.

Overall, regarding natural gas, the main countries exporting natural gas to the EU in 2022 were Russia – 22.7%, Norway – 17.1%, USA – 16.5%, Algeria – 11%, and Qatar – 5.3%. However, the energy self-sufficiency of EU countries varies. This indicator is calculated as the ratio of (primary production + renewable and processed products) to (primary production + renewable and processed products + imports + stock changes). In 2022, the most energy-self-sufficient countries were Estonia (62.11%), Romania (57.02%), and Sweden (52.60%). The least energy-self-sufficient countries were Malta (1.57%), Luxembourg (8.16%), and Cyprus (9.09%) (Eurostat, n.d.).

4) The gas storage capacity in August 2024 reached 90%, surpassing the target deadline for achieving this goal.

5) Stabilisation of energy prices – prices remain lower than the peak levels seen in 2022.

6) A 32.5% reduction in greenhouse gas emissions from 1990 to 2022, while the EU economy grew by 167%.

7) Achieving global leadership – the initiation of an international agreement to triple renewable energy capacity and improve energy efficiency, approved in Dubai.

8) Development of renewable energy, particularly wind energy, which has surpassed natural gas in the EU, becoming the second-largest source of electricity after nuclear power (European Commission, 2024).

According to reports on sustainable development and countries' progress towards UN goals in this context, since the adoption of Directive (EU) No. 2019/1 (2018), EU countries and Ukraine have shown the following changes in comparison, as illustrated in Figure 2.

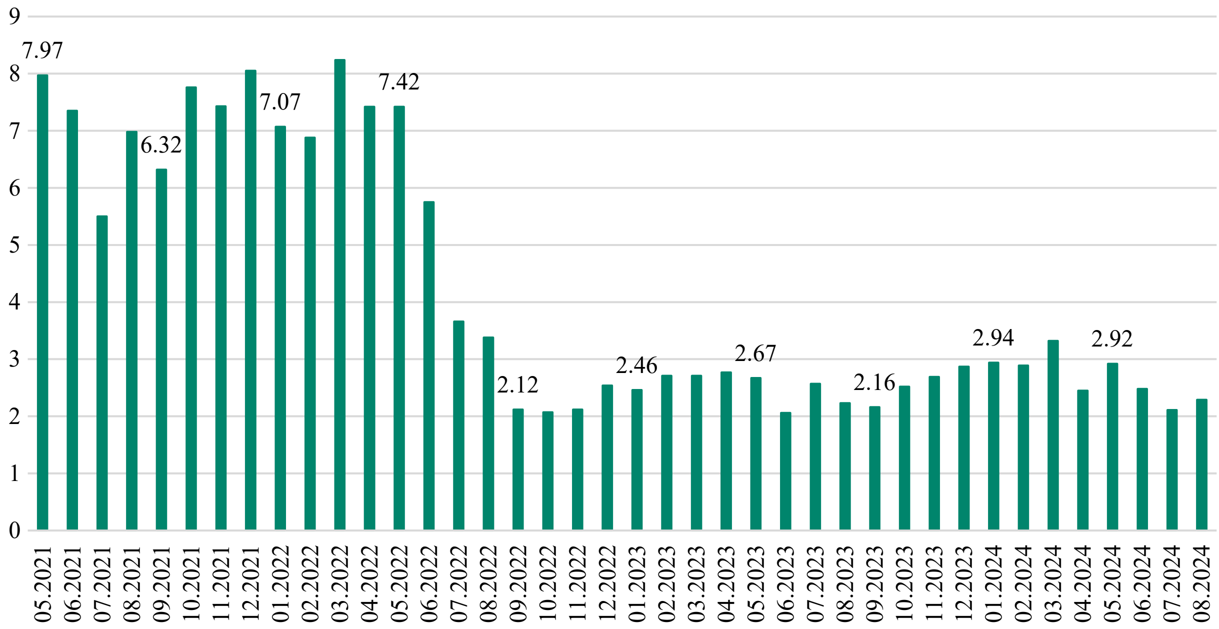

Figure 1. Monthly imports of natural gas from Russia to the EU from May 2021 to August 2024, in billions of m³
Notes: values for natural gas imports from Russia to the EU in the figure are provided at 4-month intervals
Source: compiled by the authors based on the Eurostat (n.d.)

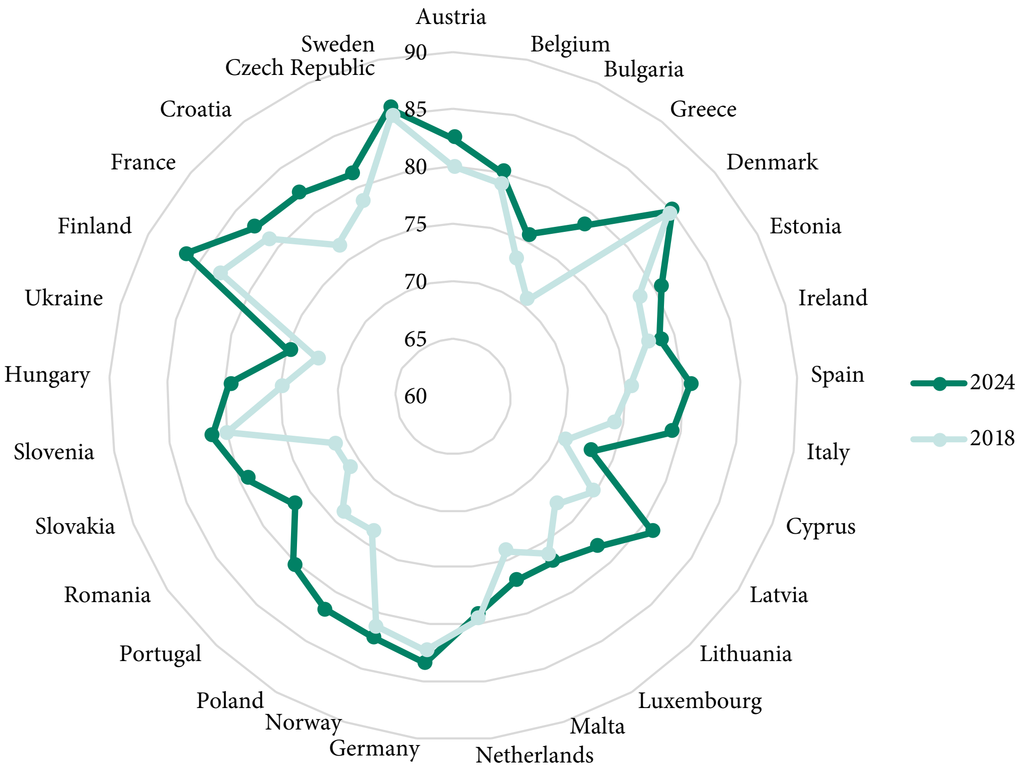

Figure 2. Achievement of Sustainable Development Goals by EU countries and Ukraine in 2018 and 2024
Source: compiled by the authors based on the J.D. Sachs *et al.* (2018), J.D. Sachs *et al.* (2024)

Among EU countries, Slovakia showed the greatest progress in achieving the 17 UN Sustainable Development Goals (an increase of 11.52% in the sustainable development index from 2018 to 2024), followed by Greece (11.47%), Latvia (8.43%), Portugal (8.38%), and Romania (8.03%). A decrease in the index was observed in only one EU country – the Netherlands (0.38%). Ukraine also improved its score in this ranking by 3.46%. The development of RES in the EU is characterised by the overall share of renewables in electricity production (Fig. 3).

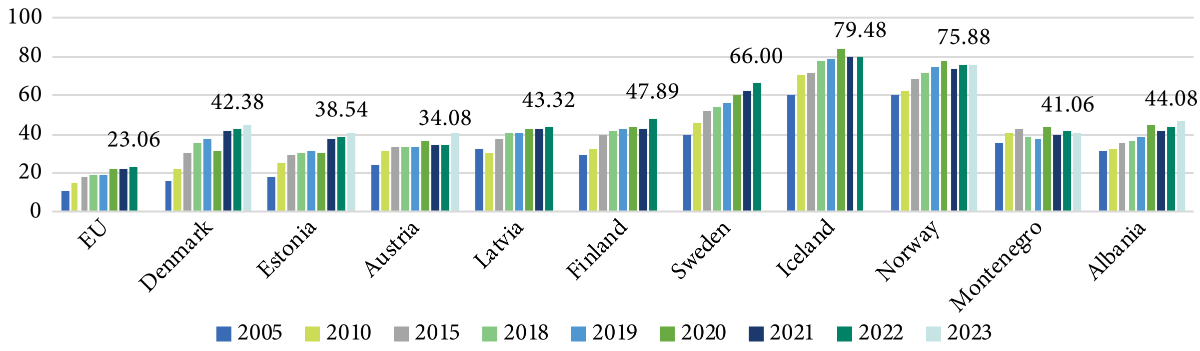

Figure 3. Share of renewable energy in total electricity production in the EU, 2005-2023
Source: compiled by the authors based on the Eurostat (n.d.)

Overall, across all EU countries, this indicator more than doubled (from 10.18% in 2005 to 23.06% in 2022). The leading countries in the EU for renewable energy development were Iceland (79.48% in 2022) and Norway (75.88% in 2022). Both countries had significant advantages at the start of the period studied (in 2005, the figures were 60.27% and 60.07%, respectively). Iceland and Norway are among the world's largest producers of hydroelectric power, making their energy sectors less reliant on fossil fuels. EU countries that have made significant progress in developing renewables include Denmark (from a share of 15.96% in 2005 to 44.92% in 2023) and Estonia (from 17.48% in 2005 to 40.95% in 2023). The EU countries with the lowest share of renewable energy in electricity production in 2022 were Ireland (13.07%), Belgium (13.76%), and the Netherlands (13.97%) (Eurostat, n.d.).

In 2023, the share of renewable energy in the EU increased by 1% compared to 2022, reaching 24.1%, which is a record high. This was helped by the adoption of several important legal measures aimed at transforming the EU's energy system, notably the Fit for 55 EU policy package and the RepowerEU plan, which was prompted by Russia's invasion of Ukraine. The target is to reach 42.5% by 2030 (European circular economy…, 2024). The RES are commonly divided into several types (solar, wind, hydro, geothermal, ambient heat, and biomass energy). For practical analysis and research purposes, renewables are often categorised into two groups: non-conventional renewables group 1 (NCR-1) – including solar, hydro, geothermal, wind, etc.; and non-conventional renewables group 2 (NCR-2), which includes energy derived from biomass, its processed products, household waste, etc. The share of renewable energy in the EU's gross final energy consumption in 2022 was 18.4%, ranking third. Oil and petroleum products held the largest share at 34.9%, followed by natural gas at 12.7%, and nuclear energy at 11.5%. The breakdown of gross final energy consumption among renewable sources in 2022 was: wind – 14.5%, hydro – 9.5%, solar – 7.7%, biofuels and renewable waste – 57.9%, and other – 10.4% (Eurostat, n.d.).

Another important indicator of the EU's renewable energy market development is energy efficiency, which is used to monitor progress towards energy-saving targets. Energy conservation can improve the security of the energy supply by reducing reliance on fuel imports. Increasing energy efficiency also boosts the competitiveness of European industry and services and helps to lower greenhouse gas emissions from burning fuel. Notably, Directive (EU) No. 2023/1791 (2023) was adopted in 2023. The main provisions of this updated Directive include a reduction of 11.7% in final energy consumption across the EU by 2030 (compared to the 2020 baseline scenario) and an increase in annual energy savings, averaging 1.49% annual savings for the period 2024-2030.

Annual primary energy consumption in the EU in 2022 was 1,257.08 Mtoe, compared to 1,235.72 Mtoe in 2020 and 1,353.36 Mtoe in 2015. Over these seven years, annual primary energy consumption in the EU countries collectively decreased by 7.11% or 96.28 Mtoe. The largest annual energy consumers among EU countries are the major economies: Germany (20.69%), France (16.30%), Italy (11.08%), Spain (9.01%), and Poland (7.83%). Since 2015, these countries have generally seen an annual reduction in primary energy consumption, except for Poland. Specifically, Germany experienced a decrease of 12.11%, France 16.14%, Italy 6.62%, and Spain 4.17%. In Poland, however, there was an increase of 9.36% over the seven years (Eurostat, n.d.).

The development of renewable energy is closely linked to the introduction of the circular economy approach (Gavkalova *et al.*, 2024). In the EU in 2024, the circular economy is a key focus for achieving sustainable development goals, improving resource efficiency, and reducing dependence on imported primary energy sources. The circular economy is a new economic and environmentally conscious development concept aimed at harmonising economic growth with ecological sustainability. The main aspects of implementing a circular economy in the EU are as follows (European circular economy…, 2024; Eionet Portal, 2024):

1) the introduction of an implementation strategy at various levels and across different sectors, particularly the European Green Deal, which directly relates to the development of the renewable energy market and the Circular Economy Action Plan as a general strategic direction. These documents focus on extending the lifespan of materials, minimising waste, and transitioning to business

models (Bochko *et al.*, 2024) that are service-oriented, eco-designed, and resourcereused, especially in critically important industries such as battery and electronics manufacturing;

2) rapid progress and interest in implementation among EU member states, with governments introducing programmes aimed at increasing recycling and material reuse rates, as well as updating legislation in waste management (Circular Economy Package). For example, there is a noticeable decoupling of resource consumption from economic growth, indicating a gradual shift towards a more circular economic model;

3) global leadership and cooperation, with the EU collaborating with international partners through initiatives such as the World Circular Economy Forum (WCEF), where particular attention is given to global supply chains and access to critical materials through the adoption of circular economy models. EU countries are at the forefront of implementing circular principles, the relevance of which continues to grow year by year.

The circular economy in Ukraine is gradually developing as an important part of its sustainable development strategy and its path towards European integration. The main directions for developing a strategy to implement the circular economy include introducing models for reusing resources, reducing waste, and increasing the use of renewable materials. In the current situation of war (2024) and its starting position regarding waste management and renewable energy development, Ukraine lags behind EU countries in this area. One of the key challenges is adapting businesses to the principles of circularity, especially during wartime, which affects economic stability and access to investment. Efforts are focused on analysing existing business models, considering the EU's experience, and developing legislative initiatives to support the transition to a new economic model.

The EU is supporting the implementation of the circular economy model in Ukraine by funding programmes to aid the transition, such as the European Structural and Investment Funds, Horizon 2020, and LIFE. Additionally, the European Investment Bank provides financing and advice for projects supporting the circular economy through the European Fund for Strategic Investments and the EU InnovFin programme. Notably, the EU-funded project "Circular Economy – Promoting Sustainable Production and Consumption Patterns in Ukraine" supports Ukraine in developing a Circular Economy Strategy in line with the Sustainable Development Goals and the European Green Deal to ensure the balanced use of resources. This project includes an analysis of economic, environmental, and social aspects, as well as the development of strategies for innovative technologies and business models (Ministry of Economy of Ukraine, 2024). Regulation of the renewable energy market in the EU aims to create favourable conditions for the integration of renewables into the European energy system, ensure the region's energy security, achieve climate targets, and decarbonise economies. The main directions in market regulation are presented in Table 2.

Table 2. Directions of renewable energy market regulation in the EU

No.	Directions	Measures
1.	Electricity market reform	In June 2024, amendments were made to EU Regulations (Regulation (EU) No. 2019/942, 2019; Regulation (EU) No. 2019/943, 2019) to improve the electricity market structure. The focus was on supporting the integration of RES, particularly solar and wind energy while ensuring stable prices for consumers even in crisis conditions. The reform includes the development of short-term markets that enhance system flexibility and adaptation to fluctuating renewable energy generation
2.	Stimulating Investment in renewable energy	The EU promotes renewable energy development through financial mechanisms, including a green energy auction system. For example, EU member states are required to develop and implement national plans aimed at increasing the share of renewable energy to 42.5% of energy consumption by 2030
3.	Digitalisation and integration of the energy system	A priority for renewable energy market development is the creation of digital solutions for managing the electricity market, which will provide system flexibility, integrate distributed generation, and enable consumer participation in the market. The development of smart grids will allow for the efficient integration of intermittent energy sources (such as solar and wind), while investments in energy storage (batteries, hydrogen) will help stabilise the system
4.	Supporting the energy transition	To reduce dependency on primary energy resources, the EU encourages the shift to renewable energy through legislative changes and the creation of new market mechanisms, including increasing market liquidity in real time for trading energy surpluses or shortages, which is crucial for variable sources such as solar and wind energy
5.	Emission trading mechanisms	The European Union Emissions Trading System (EU ETS) provides an economic incentive for transitioning to renewable energy by limiting carbon dioxide emissions

Source: compiled by the authors based on the EU provides legal framework for regulation and decarbonisation of the gas sector (2024); Directive (EU) No. 2024/1788 (2024)

The development of RES in Ukraine is a key aspect of the state's energy strategy, particularly in the context of integration into European energy markets and the transition to environmentally friendly energy sources. The development trends of the renewable energy market in Ukraine are characterised by the Order of the Cabinet of Ministers of Ukraine No. 761-r (2024):

- rapid growth in RES capacity. With significant volumes of solar and wind power plants commissioned between 2012 and 2022, they together account for more than 90% of RES capacity in Ukraine. As of 2024, the installed RES capacity in Ukraine stands at approximately 10.8 GW. However, due to the war with Russia, around 71% of wind power capacity is located in temporarily occupied territories (in the Kherson and Zaporizhzhia regions) and cannot be utilised. Additionally, about 14% of solar power plants are under occupation;
- increase in the share of RES in Ukraine's energy balance. In 2023, the share of electricity generated from RES accounted for approximately 14% of total generation. In 2010, this figure was very low compared to its current value, standing at around 1-2% of total generation. The majority of the generation was provided by large hydroelectric power stations (HPS), while solar, wind, and biomass energy played a minimal role;
- increase in legislative support for the sector. Since 2009, Ukraine has implemented the "green tariff", which provided fixed rates for RES producers and became a significant incentive for attracting investments into the sector. The concept of "green auctions" emerged in 2020 when amendments were made to renewable energy legislation. For solar stations commissioned from 2020 onwards with capacities over 1 MW, in addition to the "green" tariff, there was the opportunity to receive fair prices for the electricity generated. The auction system introduced aims to create a competitive environment, thereby reducing the cost of electricity generation;
- growth in investment activity. Notable foreign investments have been attracted, including significant contributions from the EBRD, IFC, NEFCO, and other financial institutions, which invested over 12 billion USD in the RES sector between 2019 and 2021;
- active international support. Ukraine receives substantial support from international partners for the development of RES, including technical assistance, grants, and project financing;
- obstacles to the development of RES. These include not only the ongoing military conflict on Ukrainian territory, which significantly complicates the functioning of the energy sector but also other challenges. Specifically, there are issues such as the financial debt of the state to RES producers under the "green tariff" and the need to modernise infrastructure for the integration of new RES capacities.

The prospects for the development of the renewable energy market are being shaped by the strong global interest in this as a trend towards economic decarbonisation. Despite the existing challenges, the National Renewable Energy Action Plan for the period up to 2030 in Ukraine, developed in 2024 (Order of the Cabinet of Ministers of Ukraine No. 761-r, 2024), is a strategic document that outlines the development of the sector between 2025 and 2030. According to this plan, Ukraine aims to achieve a 25% share of RES in total electricity production by 2030. Furthermore, it intends to ensure the active development of infrastructure for the generation, storage, and transmission of energy from RES and to integrate into the European electricity market through participation in ENTSO-E. Following the emergency integration in 2022, the next steps in reforming Ukraine's energy market should include decisions on creating conditions for the merging of spot markets, organising coordinated long-term auctions for the allocation of cross-border transmission capacity, joining platforms for the distribution of balancing energy and ancillary services, joint planning of energy system risks with European partners, and so on. The regulation of the renewable energy market in Ukraine is based on legislative and regulatory mechanisms aimed at developing the sector, attracting investment, and integrating into the European energy system. The institutional framework for the renewable energy market in Ukraine is focused on stimulating the growth of this sector (Table 3).

For the further development of the RES sector in Ukraine, systemic reforms are needed to support investors, create transparent conditions for competition, and encourage innovation. The main challenges in the current environment are high risks for investors due to the unstable economic situation and the war, the need to improve energy infrastructure, and to ensure integration with the European market. The prospects for the development of the renewable energy market in the EU remain strong due to ambitious climate targets, substantial financial support, and innovative technologies.

Table 3. Institutional support for the renewable energy market in Ukraine

No.	Directions	Measures
1.	Legislative framework	The Law of Ukraine No. 555-IV (2003) is the foundational document that outlines the legal framework for the functioning of the renewable energy market. The "green tariff", introduced by the Law of Ukraine No. 1164-VI (2009), is a stimulation mechanism that guarantees a fixed payment for electricity generated from RES. Since 2020, it has gradually been replaced by an auction system to determine competitive electricity prices (Law of Ukraine No. 2019-VIII, 2017). However, in 2024, the focus shifts to implementing incentive tariffs for the development of decentralised solutions (solar energy on rooftops, and small wind farms) and energy storage systems. Laws supporting energy storage systems and microgeneration, which introduce modern technologies into the sector, are part of Ukraine's overall strategy for modernising its energy system and achieving climate neutrality by 2050. These laws contribute to the integration of RES, reduction of CO_2 emissions, and attraction of investment in advanced technologies

Table 3. Continued

No.	Directions	Measures
2.	Role of regulators	The National Commission for State Regulation of Energy and Public Utilities (NCREPU) is responsible for setting tariffs and monitoring the activities of market participants. The State Agency for Energy Efficiency and Energy Saving of Ukraine formulates policies in the areas of energy efficiency and renewable energy. Additionally, these agencies regulate market activities and oversee the implementation of decarbonisation strategies. Civil society organisations, such as the Ukrainian Wind Energy Association, contribute to the development of innovative solutions in RES and foster collaboration between investors, local authorities, and communities
3.	Auction system	Since 2020, an auction system has been in operation, gradually replacing the "green tariff" for energy generated from RES. This ensures competition among producers and reduces the cost of produced energy
4.	Investment prospects	Despite the ongoing war, investments in RES in Ukraine remain economically viable due to the long-term competitiveness of wind and solar energy. The sector is supported by international partners, including the EBRD, which finances projects aimed at modernising energy infrastructure
5.	Integration into European markets	Ukraine is adapting its legislation to European standards, including directives on RES development and economic decarbonisation. After joining the ENTSO-E energy system, the country gained the ability to export and import energy within the unified European market

Source: compiled by the authors based on the European business association (2024)

Decarbonisation in the EU is a key priority in the fight against climate change, part of the goal to achieve climate neutrality by 2050, as enshrined in the European Green Deal. To achieve this, the EU is implementing a wide range of measures across different sectors of the economy. Specifically, this includes: reducing greenhouse gas emissions – by 2030, the EU aims to cut emissions by at least 55% compared to 1990 levels, a legally binding target, with the goal of achieving net-zero CO_2 emissions by 2050; a complete transition to RES, phasing out coal and significantly reducing the use of natural gas, and promoting the development of a hydrogen economy as an alternative to fossil fuels; the introduction of the emissions trading system (EU ETS) – one of the largest systems in the world, covering over 40% of greenhouse gas emissions in the EU; the implementation of CO_2 emissions reduction requirements for cars, including a ban on the sale of new internal combustion engine vehicles from 2035, investment in the development of infrastructure for electric vehicles and railway transport; the creation of programmes for forest and soil conservation as natural carbon sinks, and the transition to sustainable farming, which includes reducing the use of chemical fertilisers and pesticides; the intensification of investments and funding – the Just Transition Fund supports regions dependent on fossil fuels, while the Climate Target Plan 2030 funds the transition to RES and energy efficiency; the carbon border adjustment mechanism (CBAM), which requires importers to pay for carbon emissions generated during the production of goods outside the EU, encourages other countries to also implement decarbonisation measures (Sustainable Development Solutions Network, n.d.). These ambitious goals create risks and obstacles in the implementation of measures. The high cost of transforming the region's economy, the need to coordinate measures between member states, and the search for socially just solutions to support populations potentially negatively affected by the decarbonisation trend (such as job losses in the fossil fuel sectors) must be considered in further implementation.

DISCUSSION

Academic studies analysing RES in Europe and globally demonstrate the relevance and multifaceted nature of this topic. The findings of several researchers have been considered and presented separately for a clearer understanding of their approaches and perspectives in studying this area. Decarbonisation, as a new imperative for energy development and a global trend in economic growth, is highlighted in the research of many academics. In the research of E. Papadis & G. Tsatsaronis (2020), the challenges on the path to decarbonising the energy sector are central to scholarly inquiry and are defined in terms of environmental sustainability, security of energy supply, economic stability, and social aspects. P. Cheekatamarla *et al.* (2024) examine various pathways to achieving decarbonisation in the energy sector, including several scenarios that involve a transition to low-carbon electricity generation sources (RES and nuclear energy), as well as reducing carbon emissions from fuel consumption through electrification and the use of alternative fuels. The challenges and opportunities associated with each scenario are discussed, including technological advancements, policy frameworks, and public acceptance. Energy security is also impacted by military conflicts (Semenenko *et al.*, 2024). Such diverse approaches to studying the problem provide a comprehensive understanding of their potential application in the practice of other countries, particularly Ukraine, in reforming the energy sector and implementing European standards.

H. Kete (2023) notes in their research the increasing importance of RES in EU policy against a backdrop of declining fossil fuel and nuclear energy use and a rising share of natural gas, which contributed to higher energy prices following the start of the Russian-Ukrainian war in 2022. The European Green Deal and the REPowerEU Plan are key aspects of the European strategy for developing RES, which is relevant in the context of transitioning to climate neutrality, promoting global growth in clean energy investment, and reducing environmental problems. These conclusions align with the findings of this study and confirm the ongoing process of examining the role of renewable energy in EU policy.

S. Wolf *et al.* (2021) delve deeper into the implementation of the European Green Deal, presenting goals for modernising the European building stock, updating the European innovation system, and additional measures in education and healthcare, thereby shaping an investment profile to achieve these objectives. Their proposals offer a new path for the region's development towards carbon neutrality and European unity, which is also relevant for Ukraine to adopt and implement such experiences.

P. Nowak & M. Dorota (2024) assessed the development of RES in Poland and the fulfilment of its commitments regarding the level of renewable energy consumption across different economic sectors. The results of analysing several countries provided a basis for grouping them according to their level of RES development, revealing regional differences and the achievement of consumption targets. The analysis methods and approaches to grouping by regional differences could be used in future research on Ukraine's energy sector. At the same time, A. Makurin *et al.* (2024), despite the state of war, are also conducting research on regulating decarbonisation processes at both national and local levels, which will contribute to economic stability, particularly during wartime. Their scientific contributions will provide an opportunity to accelerate the transition to carbon neutrality and convergence with European standards after the war ends.

M. Simionescu *et al.* (2024) assessed the impact of a country's energy poverty and the level of renewable energy consumption on carbon emissions in 10 Central and Eastern European countries (EU member states) between 2005 and 2022. The study's findings indicated that the promotion of renewable energy in 2009 through relevant regulations helped to lower CO_2 emissions in each of these countries compared to non-EU countries in the region (including Ukraine). Energy poverty in a country increases CO_2 emissions, while renewable energy consumption reduces them. This demonstrates a direct link between the need to implement renewable energy in Ukraine and its progress towards carbon neutrality, as well as the value of learning from the experiences of other nations to accelerate these transformations.

Alongside decarbonisation, the trend of the circular economy is inextricably linked, with both sharing the common goal of tackling carbon emissions. S.K. Ghosh & S.K. Ghosh (2023) point out that the circular economy acts as a catalyst for decarbonisation and helps to reduce the extraction of natural resources. Environmental concerns and decarbonisation are at the forefront of the political agenda in many countries. In particular, climate change and the increasing negative impact of this issue on humanity are prompting countries to take new measures and examine environmental performance. In this context, K.S. Mohammed *et al.* (2024) investigated environmental governance indicators, which play an important role at both country and company levels, and the practice of their implementation is being actively pursued in Ukraine, even despite the state of war.

A significant contribution to the research on economic decarbonisation, its impact on carbon emissions, and the role of renewable energy has been made by the group of scientists Y.A. Twumasi *et al.* (2024), who conducted a comparative analysis of some decarbonisation strategies adopted by the USA and the EU to reduce greenhouse gas emissions. The modelling results showed a decrease in average carbon emissions in the USA by 2030 and an increase in emissions in EU countries. The application of significantly different economic decarbonisation strategies by these two regions (the USA has historically relied on coal, oil, natural gas, nuclear energy, and renewables; the EU is showing decarbonisation strategies focused on electrification and carbon-neutral energy, as well as energy efficiency) demonstrates different modelling outcomes. While errors and the influence of various factors on the modelling results are possible in such a complex process, the conclusion about the need to address climate change and mitigate the consequences of rising emissions worldwide remains relevant.

CONCLUSIONS

The European renewable energy market plays a crucial role in achieving climate neutrality targets by 2050 and has a positive impact on the development of national economies in the region. Through the implementation of key renewable energy sources (solar, wind, biomass), greenhouse gas emissions are being reduced, which is a primary priority of the EU's decarbonisation policy. The active involvement of private and public investment in the development of renewables, together with European initiatives, is driving large-scale funding for infrastructure, energy storage technologies, and "green" hydrogen. The integration of smart grids and energy storage systems allows for the balancing of energy production and consumption, increasing the reliability of the system and the efficiency of renewables. EU legislation provides effective regulatory support and ensures favourable conditions for the expansion of the renewable energy market, regulating its integration into various sectors (transport, construction, industry).

Despite the significant advantages and effectiveness of the reforms, there is a geographical unevenness in development, meaning that the renewable energy market in Europe shows considerable differences between countries. Regions with developed infrastructure and favourable climate conditions (for example, Northern Europe) are growing faster than regions with less funding or geographical limitations, which creates challenges for aligning implementation policies. Future research should focus on finding solutions to such challenges in the sector's development, such as: integrating intermittent energy sources (solar and wind generation) into the energy system with an economic justification of potential risks, developing ways to optimise and reduce the high cost of modernising energy systems, and exploring proposals to overcome the socio-economic consequences of the widespread adoption of renewables for regions dependent on fossil fuels, and so on. Overall, the prospects for the development of the renewable energy market are optimistic, and it is expected that renewables will become the main source of energy in the EU by 2050, thanks to a comprehensive approach to decarbonisation and the promotion of innovation.

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REFERENCES

[1] Bochko, O., Zarichna, O., & Kuziak, V. (2024). Transformation of business ecosystems of the energy sector enterprises. *Development Management*, 23(1), 62-71. doi: 10.57111/devt/1.2024.62.

[2] Cheekatamarla, P., Gluesenkamp, K., Kowalski, S., Li, Z., & Jajja, S. (2024). Decarbonization scenarios. In *The role of fuels in transforming energy end-use in buildings and industrial processes* (pp. 45-49). Cham: Springer. doi: 10.1007/978-3-031-45365-6_8.

[3] Constant, K., Davin, M., de Truchis, G., & Keddad, B. (2024). The European renewable energy sector in calm and turmoil periods: The key role of sovereign risk. *The Energy Journal, 45*(5), 65-89. doi: 10.1177/01956574241240293.

[4] Directive (EU) No. 2019/1 of the European Parliament and of the Council Directive "To Empower the Competition Authorities of the Member States to Be More Effective Enforcers and to Ensure the Proper Functioning of the Internal Market". (2018, December). Retrieved from https://eur-lex.europa.eu/eli/dir/2019/1/oj.

[5] Directive (EU) No. 2023/1791 of the European Parliament and of the Council "On Energy Efficiency and Amending Regulation (EU) 2023/955 (recast)". (2023, September). Retrieved from https://eur-lex.europa.eu/eli/dir/2023/1791/oj.

[6] Directive (EU) No. 2024/1788 of the European Parliament and of the Council "On Common Rules for the Internal Markets for Renewable Gas, Natural Gas and Hydrogen, Amending Directive (EU) 2023/1791 and Repealing Directive 2009/73/EC (recast)". (2024, June). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401788.

[7] Eionet Portal. (2024). *Country profiles on circular economy in Europe*. Retrieved from https://www.eionet.europa.eu/etcs/etc-ce/products/country-profiles-on-circular-economy-in-europe.

[8] EU provides legal framework for regulation and decarbonisation of the gas sector. (2024). Retrieved from https://www.arthurcox.com/knowledge/eu-provides-legal-framework-for-regulation-and-decarbonisation-of-the-gas-sector/.

[9] European Business Association. (2024). *BDO in Ukraine – overview of legislative changes and prospects for RES development in the green energy market*. Retrieved from https://eba.com.ua/en/bdo-v-ukrayini-oglyad-zakonodavchyh-zmin-ta-perspektyv-rozvytku-vde-na-rynku-zelenoyi-energetyky/.

[10] European circular economy 2024 conference kicks off in Brussels. (2024). Retrieved from https://environment.ec.europa.eu/news/european-circular-economy-2024-conference-kicks-brussels-2024-04-15_en.

[11] European Commission. (2024). *State of the Energy Union Report 2024*. Retrieved from https://energy.ec.europa.eu/document/download/bd3e3460-2406-47a1-aa2e-c0a0ba52a75a_en?filename=State%20of%20the%20Energy%20Union%20Report%202024.pdf.

[12] European Environment Agency. (2025). *Share of energy consumption from renewable sources in Europe*. Retrieved from https://www.eea.europa.eu/en/analysis/indicators/share-of-energy-consumption-from?activeAccordion=309c5ef9-de09-4759-bc02-802370dfa366.

[13] Eurostat. (n.d.). Retrieved from https://ec.europa.eu/eurostat/web/main/home.

[14] Gavkalova, N., Martin, J., Shumska, H., & Babenko, K. (2024). Landscape and circular economy as a mechanism of sustainable development in globalisation and digitalisation of the world economy. *Economics of Development*, 23(2), 80-90. doi: 10.57111/econ/2.2024.80.

[15] Ghosh, S.K., & Ghosh, S.K. (2023). Circular economy catalyzing decarbonization. In *Circular economy adoption* (pp. 3-33). Singapore: Springer. doi: 10.1007/978-981-99-4803-1_1.

[16] Green Transformation of Ukraine. (2024). *10 EU countries have committed to decarbonising their energy sectors by 2035*. Retrieved from https://greentransform.org.ua/10-krayin-yes-zobov-yazalysya-dekarbonizuvaty-energetyku-do-2035-roku/.

[17] Jaworski, S., Chrzanowska, M., Zielińska-Sitkiewicz, M., Pietrzykowski, R., Jezierska-Thöle, A., & Zielonka, P. (2023). Evaluating the progress of renewable energy sources in Poland: A multidimensional analysis. *Energies, 16*(18), article number 6431. doi: 10.3390/en16186431.

[18] Kete, H. (2023). The future of renewable energy policies in the European Union. *Journal of European Theoretical and Applied Studies*, 11(2), 9-24.
[19] Kharin, S., Ivanova, M., & Kotenko, A. (2024). Modern trends in global energy in the context of sustainable development and decarbonization. *Economy and Society, 68*. doi: 10.32782/2524-0072/2024-68-31.
[20] Kosowski, P. (2024). From fossil fuels to renewables: Clustering European primary energy production from 1990 to 2022. *Energies, 17*(22), article number 5596. doi: 10.3390/en17225596.
[21] *Law of Ukraine No. 1164-VI "On Amendments to the Law of Ukraine 'On Electricity' to Regulate Electricity Exports"*. (2009, March). Retrieved from https://zakon.rada.gov.ua/laws/show/1164-17#Text.
[22] Law of Ukraine No. 2019-VIII "On the Electricity Market". (2017, April). Retrieved from https://zakon.rada.gov.ua/laws/show/2019-19#Text.
[23] *Law of Ukraine No. 555-IV "On Alternative Energy Sources". (2003, February)*. Retrieved from https://zakon.rada.gov.ua/laws/show/555-15#Text.
[24] Makurin, A., Usatenko, O., & Shyshkova, N. (2024). Current tools to control decarbonization in Ukraine both governmentally and locally. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu, 3,* 108-115. doi: 10.33271/nvngu/2024-3/108.
[25] Ministry of Economy of Ukraine. (2024). *The Ministry of Economy hosted a meeting of the interdepartmental working group on the development of the circular economy*. Retrieved from https://surli.cc/pmndmy.
[26] Mohammed, K.S., Pata, U.K., Serret, V., & Kartal, M.T. (2024). The role of renewable energy and carbon dioxide emissions on the ESG market in the European Union. *Managerial and Decision Economics, 45*(7), 5146-5158. doi: 10.1002/mde.4316.
[27] Nowak, P., & Dorota, M. (2024). *Acquisition and consumption of energy from renewable sources in European Union countries. Economics and Environment*, 90(3), article number 805. doi: 10.34659/eis.2024.90.3.805.
[28] Order of the Cabinet of Ministers of Ukraine No. 761-r "On Approval of the National Renewable Energy Action Plan for the period up to 2030 and the Action Plan for Its Implementation". (2024, August). Retrieved from https://zakon.rada.gov.ua/laws/show/761-2024-%D1%80#Text.
[29] Pang, L., Liu, L., Zhou, X., Hafeez, M., Ullah, S., & Sohail, M.T. (2024). How does natural resource depletion affect energy security risk? New insights from major energy-consuming countries. *Energy Strategy Reviews, 54,* article number 101460. doi: 10.1016/j.esr.2024.101460.
[30] Papadis, E., & Tsatsaronis, G. (2020). Challenges in the decarbonization of the energy sector. *Energy, 205,* article number 118025. doi: 10.1016/j.energy.2020.118025.
[31] Pedraza Morales, J. (2024). The European Union toward a green economy: Current situation and perspective in the use of renewables for electricity generation. *Sustainable Economies, 2*(3), article number 218. doi: 10.62617/se.v2i3.218.
[32] Regulation (EU) No. 2019/942 of the European Parliament and of the Council "Establishing a European Union Agency for the Cooperation of Energy Regulators". (2019, June). Retrieved from https://eur-lex.europa.eu/eli/reg/2019/942/oj/eng.
[33] Regulation (EU) No. 2019/943 of the European Parliament and of the Council "On the Internal Market for Electricity". (2019, June). Retrieved from https://eur-lex.europa.eu/eli/reg/2019/943/oj/eng.
[34] Rimšaitė, L. (2024). European energy market evolution. In *The crossroads of competition law and energy regulation* (pp. 9-41). Cham: Springer. doi: 10.1007/978-3-031-73238-6_2.
[35] Sachs, J.D., Lafortune, G., & Fuller, G. (2024). *Sustainable development report*. Dublin: Dublin University Press.
[36] Sachs, J.D., Schmidt-Traub, G., Kroll, C., Lafortune, G., & Fuller, G. (2018). *SDG index and dashboards report*. New York: Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN).
[37] Semenenko, O., Kirsanov, S., Movchan, A., Yarmolchyk, M., & Ihnatiev, M. (2024). Economic impact of military conflicts on energy markets and global energy security. *Scientific Bulletin of Mukachevo State University. Series "Economics"*, 11(2), 79-89. doi: 10.52566/msu-econ2.2024.79.
[38] Simionescu, M., Radulescu, M., & Belascu, L. (2024). The impact of renewable energy consumption and energy poverty on pollution in Central and Eastern European countries. *Renewable Energy*, 236, article number 121397. doi: 10.1016/j.renene.2024.121397.
[39] Soeiro, S., & Ferreira Dias, M. (2020). Renewable energy community and the European energy market: Main motivations. *Heliyon, 6*(7), article number e04511. doi: 10.1016/j.heliyon.2020.e04511.
[40] Song, M., Xu, H., Shen, Z., & Pan, X. (2022). Energy market integration and renewable energy development: Evidence from the European Union countries. *Journal of Environmental Management, 317,* article number 115464. doi: 10.1016/j.jenvman.2022.115464.
[41] Sustainable Development Solutions Network. (n.d.). *European Green Deal Policies and Sustainability*. Retrieved from https://egd-report-2023.unsdsn.org/european-green-deal-policies-and-sustainability/.
[42] Twumasi, Y.A., *et al.* (2024). Decarbonization strategies in the United States of America and the European Union (EU): A comparative analysis. *Low Carbon Economy*, 15(4), 61-94. doi: 10.4236/lce.2024.154004.

[43] Veghes, C., Str, A., & Stoenică, L. (2024). EU consumers, renewable energy, and sustainable development. *European Journal of Sustainable Development,* 13(4), article number 85. doi: 10.14207/ejsd.2024.v13n4p85.
[44] Wolf, S., Teitge, J., Mielke, J., Schütze, F., & Jaeger, C. (2021). *The European Green Deal – more than climate neutrality. Intereconomics*, 56, 99-107. doi: 10.1007/s10272-021-0963-z.

Катерина Кузнєцова
Кандидат економічних наук, доцент
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
03056, просп. Берестейський, 37, м. Київ, Україна
https://orcid.org/0000-0003-0162-1071

Анна Омельченко
Кандидат економічних наук
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
03056, просп. Берестейський, 37, м. Київ, Україна
https://orcid.org/0000-0001-9376-7566

Олександр Ченуша
Кандидат економічних наук
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
03056, просп. Берестейський, 37, м. Київ, Україна
https://orcid.org/0000-0001-7184-2705

Аналіз європейського ринку відновлюваних джерел енергії в контексті тренду декарбонізації

Анотація. Метою статті був аналіз тенденцій розвитку ринку відновлюваних джерел енергії (ВДЕ) в ЄС з акцентом уваги на їх ролі у декарбонізації енергетичного сектору. Досліджено динаміку енергоспоживання в ЄС у 2000-2022 рр., проаналізовано роль ВДЕ у досягненні цілей сталого розвитку, проведено порівняння розвитку ринку ВДЕ та енергетичної системи ЄС та України в контексті її вектору євроінтеграції. Особливу увагу приділено імперативу циркулярної економіки як провідної моделі економіки. Визначено вплив циркулярної економіки на розвиток світового господарства, що полягає у зменшенні обсягів відходів та залежності від імпорту енергоносіїв. Проведено статистичний аналіз залежності ЄС від імпорту природного газу, визначено скорочення викидів парникових газів та зростання частки ВДЕ у виробництві електроенергії. Встановлено, що ЄС активно долає виклики енергетичної безпеки, зокрема через розвиток вітроенергетики та сонячних станцій, та зберігає глобальне лідерство в енергетичній трансформації регіону. Встановлено, що за період 2005-2022 рр. частка ВДЕ у виробництві електроенергії в ЄС зросла з 10,18 % до 23,06 %. Лідерами в цьому стали Ісландія та Норвегія завдяки розвинутій гідроенергетиці. У 2023 р. частка ВДЕ досягла історичного максимуму – 24,1 %, що сприяло зміцненню енергетичної незалежності ЄС. Основними факторами зростання стала імплементація правових ініціатив, зокрема Fit-for-55 та RepowerEU. Розглянуто структуру споживання енергії в ЄС, де на ВДЕ припадає 18,4 %, і підкреслюється важливість підвищення енергоефективності. Наведено ключові досягнення у розвитку ринку ВДЕ в Україні, виклики та перспективи в сучасних реаліях, серед яких інтеграція в європейську енергосистему через ENTSO-E. Окреслено позитивний вплив ВДЕ на екологічну стійкість і конкурентоспроможність економік ЄС та України, водночас звертаючи увагу на необхідність усунення географічних і соціально-економічних бар'єрів при імплементації регуляторних механізмів та правових ініціатив

Ключові слова: відновлювальна енергетика; тенденції розвитку; європейський енергетичний простір; енергетична система; циркулярна економіка; вуглецева нейтральність; ESG-принципи

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Oleh Karyy*
Doctor of Economics, Professor
Lviv Polytechnic National University
79013, 12 Stepan Bandera Str., Lviv, Ukraine
https://orcid.org/0000-0002-1305-3043

Ihor Kulyniak
PhD in Economics, Associate Professor
Lviv Polytechnic National University
79013, 12 Stepan Bandera Str., Lviv, Ukraine
https://orcid.org/0000-0002-8135-4614

Solomiya Ohinok
PhD in Economics, Associate Professor
Lviv Polytechnic National University
79013, 12 Stepan Bandera Str., Lviv, Ukraine
https://orcid.org/0000-0001-5462-5362

Yuliia Bondarenko
PhD in Economics, Associate Professor
Lviv Polytechnic National University
79013, 12 Stepan Bandera Str., Lviv, Ukraine
https://orcid.org/0000-0002-2362-7629

Cooperation between travel agencies and tour operators in the organisation of heritage and cultural tourism trips in the European Union countries

Abstract. This study aimed to develop a cluster-based structure of the tourism market and to identify trends in the development of the tourism sector by assessing the productivity of travel agencies and tour operators in the European Union and Ukraine in the context of organising international and domestic heritage and cultural tourism trips. The analysis employed a range of methods, including cluster analysis, statistical techniques, data standardisation, a matrix-based approach, and comparative analysis. To evaluate the productivity of tourism enterprises, the following indicators were calculated: value added per enterprise, turnover per enterprise, value added per employee, and turnover per employee. The application of hierarchical clustering enabled the classification of countries into three groups based on the productivity levels of travel agencies and tour operators: high, medium, and low. Ukraine was placed in the group with low productivity for both travel agencies and tour operators. The findings revealed that most EU countries demonstrate stable productivity in both categories of tourism enterprises, indicating a consistent level of tourism market development. However, some countries exhibit discrepancies between the productivity levels of travel agencies and tour operators. These differences can be attributed to specific market conditions, business strategies, and the underlying economic model of tourism. To determine whether travel agencies and tour operators are primarily focused on organising domestic or international tourism trips, and

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*Corresponding author

to evaluate their effectiveness in these areas, an indicator reflecting the ratio of organised domestic to international tourism trips is proposed. Using a matrix approach, which cross-references the productivity level of tourism enterprises with the direction of tourism flows, EU countries were clustered according to similarities in their performance in organising heritage and cultural tourism trips. The results of the grouping suggest that domestic tourism is a key factor contributing to the high productivity of tourism enterprises in leading EU countries. The findings may inform the development of strategies aimed at improving the efficiency of tourism enterprises, including through optimising business models, attracting international tourists, and enhancing the organisation of domestic tourism trips

Keywords: tourism enterprise; historical and cultural heritage; efficiency; productivity; tourism market; international and domestic tourism

INTRODUCTION

Heritage and cultural tourism are vital components of the tourism industry, particularly in the European Union, which hosts numerous World Heritage Sites. Organising such trips requires well-coordinated interaction between tour operators and travel agencies, as they play a key role in developing itineraries, managing logistics, booking services, and promoting destinations. In the current context of market competition and digitalisation, tourism companies actively seek new collaboration models that optimise processes and enhance service quality. Establishing effective communication between tour operators, who develop comprehensive tourism products, and travel agencies, which directly interact with clients and shape demand, is particularly important.

Tourism companies may focus on different operational directions: international or domestic tourism. International tourism primarily involves attracting travellers to cross-border journeys, which requires an extensive network of global partnerships, adapting offers to various market demands, and complying with the regulatory frameworks of different countries. Meanwhile, domestic tourism promotes national cultural heritage, stimulates regional development, and creates attractive tourism products for residents. Regardless of the chosen focus, the operational efficiency of tourism companies is a key factor in their competitiveness and long-term success. Efficiency is particularly critical in the face of global challenges such as economic instability, shifting traveller preferences, environmental regulations, and the impact of global crises on the travel industry. Therefore, studying the performance of tour operators and travel agencies and identifying ways to enhance their efficiency is a timely and relevant research objective. Analysing trends and challenges will improve understanding of heritage and cultural tourism organisations and support more informed managerial decision-making in this sector.

Research on the role of tour operators and travel agencies in organising heritage and cultural trips in the European Union is gaining increasing significance in academic literature. Researchers are placing growing emphasis on the importance of integrating advanced technologies and digital platforms, which are significantly transforming the travel planning process. One key area of study involves analysing recommendations generated through traveller reviews on online platforms and tourists' activities during hotel or flight bookings, which contributes to the development of personalised travel itineraries (Nikas, 2024).

The efficiency of tourism companies is another actively researched topic, as the competitiveness and sustainable development of the industry largely depend on companies' ability to adapt to market changes, technological progress, and consumer trends. For instance, Croatian scholars V. Zaninović & A. Host (2021) analyse the impact of firm-level variables (total assets, number of employees) and country-level variables (number of arrivals) on the operational revenues of travel agencies and tour operators in the EU. Their findings indicate significant differences between the determinants of operational revenues for travel agencies and tour operators, with even more pronounced disparities between Northern and Southern European countries.

Another group of researchers, A. Coelho & V.M. Castillo-Girón (2020), investigate the determinants of exchange environments in mergers and acquisitions within the tourism industry. They conclude that travel agencies and tour operators operate in an unstable environment, where industry investments involve substantial sunk costs in addition to economies of scale. A study of Polish travel agencies in the context of global health threats (Franczak & Bakota, 2024) reveals that companies may resort to manipulating profitability indicators through accrual management during periods of economic instability. This highlights the importance of a comprehensive analysis of both operational efficiency and financial transparency among tourism enterprises within the integrated economic space of the EU.

While the aforementioned studies primarily focus on financial and operational indicators, scholars P. Rodríguez & J.S. García (2022) emphasise the role of influencers in enhancing the efficiency of tourism companies' digital marketing. Their research examines travel agencies and tour operators, providing an overview of the most advanced methods for measuring digital marketing performance employed by leading tourism firms in Spain. Additionally, the specificity and productivity of tourism companies are influenced by risk and environmental instability. This aspect is explored in studies by A. Grigorescu *et al.* (2021), as well as I. Veríssimo & R. Costa (2021). These researchers analyse the significance of travel agencies within the tourism sector, the risk management strategies they can adopt, and measures to mitigate risks and potential consequences during times of crisis.

An important topic in academic publications is the study of domestic and international tourism. For example, researchers G. Harb & C. Bassil (2022), using regional data from EU countries, assess the impact of tourist arrivals (total, domestic, and foreign) on regional growth from 2000 to 2018. Their findings indicate that the influx of domestic and total tourism contributes positively and significantly to regional development. In contrast, the positive effect of foreign tourism is statistically evident primarily in regions that serve as key destinations for international tourists. Similarly, scholars E. Sánchez-Dávila & L.Y. García (2025) examine how the origin of tourism – domestic or foreign – affects poverty reduction. Their research concludes that domestic tourism contributes more significantly to poverty alleviation than international tourism, even though, on average, foreign tourists tend to stay longer in tourist destinations than domestic travellers. These researchers underscore the need to prioritise domestic tourism development within poverty reduction policies.

Thus, scholars dedicate significant attention to examining the efficiency of tourism companies, including analyses of their business models, the impact of various determinants on performance, the effectiveness of marketing strategies, and their resilience to market fluctuations. Additionally, the role of domestic and international tourism in the development of the tourism industry is extensively explored, particularly regarding their effects on the economy, regional employment, and cultural exchange. However, despite the extensive body of research in this field, there remains insufficient exploration of the productivity of travel agencies and tour operators in EU countries in relation to the organisation of both international and domestic tourism trips. In particular, the effectiveness of their collaboration, the optimisation of operational processes, and the implementation of innovative strategies to enhance competitiveness in the European market remain open questions. This highlights the need for further analysis of the mechanisms and outcomes of their activities, as well as the identification of ways to improve the efficiency of tourism operations. This article aimed to assess the efficiency of travel agencies and tour operators in EU countries in organising heritage and cultural international and domestic tourism trips.

MATERIALS AND METHODS

This study was conducted in several stages to determine the efficiency of travel agencies and tour operators in EU countries in organising heritage and cultural tourism trips, both international and domestic (Fig. 1).

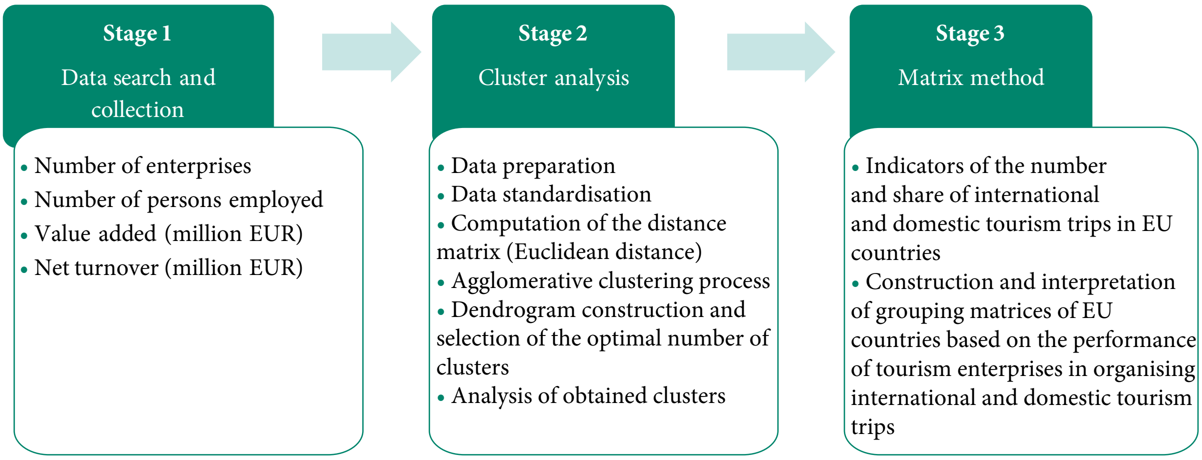

Figure 1. Research methodology

Source: compiled by the authors

The first stage involved searching for and collecting statistical data on the activities of tourism companies. The statistical basis for the study comprised data on the operations of travel agencies and tour operators published by the Statistical Office of the European Union (Eurostat, 2025a; 2025b). In the second stage, a cluster analysis method was applied to the process of statistical data by grouping Ukraine and EU countries based on the productivity levels of travel agencies and tour operators. The statistical reports provide absolute data on the number of enterprises, employees, value added, net turnover, and other indicators. However, using relative productivity indicators allows for a more meaningful classification of countries according to the level of development and efficiency of tourism industry entities. Therefore, the following relative productivity indicators were proposed for analysis: Value added per enterprise = Value added / Enterprises; Net turnover per enterprise = Net turnover / Enterprises; Value added per employee = Value added / Persons employed; Net turnover per employee = Net turnover / Persons employed.

According to the authors, the use of productivity indicators instead of absolute values enables:

• Ensuring comparability between countries regardless of their scale. For example, a large number of tourism enterprises in a country does not necessarily indicate high efficiency;

• Reflecting the efficiency level of the tourism sector rather than merely its overall size;

• Reducing the influence of population size and country area, focusing instead on the productivity of tourism enterprises and employees.

The hierarchical clustering algorithm consisted of the following stages: data preparation; data standardisation to ensure a uniform measurement scale; calculation of the distance matrix (Euclidean distance was used to determine the similarity between objects); agglomerative clustering process (pairwise merging of the closest clusters based on the selected linkage criterion – Ward's method); visualisation of the hierarchical cluster structure using a dendrogram and determination of the optimal number of clusters; analysis of the resulting clusters and identification of the characteristics of each country group. The hierarchical cluster analysis was conducted using STATISTICA 10 software.

Consistent and finalised datasets were required to accurately apply cluster, matrix, and comparative analysis. For this reason, the year 2022 was chosen as the base year for the study, as statistical data – particularly at the EU country level – are typically published with a significant delay and generally become available only 1.5 to 2 years after the end of the reporting period. At the time the research was conducted, the data for 2022 were the most recent fully available and suitable for comparative analysis. Data for 2023-2024 had not yet been finalised and remained incomplete, posing a risk of distorting the research findings.

The third stage involved constructing matrices to compare the productivity levels of tourism enterprises with the focus of tourism trips. Indicators were used to classify countries based on the orientation of tourism enterprises, reflecting the ratio of organised domestic and international tourist trips. As a result of applying the matrix method, EU countries were grouped according to the productivity of tourism enterprises in organising heritage and cultural tourism trips for both international and domestic purposes.

RESULTS AND DISCUSSION

Statistical data on the activities of travel agencies and tour operators in Ukraine and EU countries are grouped according to the detailed types of economic activity based on the NACE Rev. 2 classification (the European system for classifying economic activities). These data are presented in Section N, Administrative and Support Service Activities, Division 79, Travel agency and tour operator activities, other reservation service and related activities (State Statistics Committee of Ukraine, 2010): 1) Class 79.11 Travel agency activities. This class includes the activities of agencies engaged in organising travel and tours and providing short-term accommodation services, which are sold both wholesale and retail to a broad range of consumers or commercial clients. 2) Class 79.12 Tour operator activities. This class includes the organisation and execution of tours, which are sold either through travel agencies or directly by tour operators. Tour organisation may include transportation, accommodation, catering, visits to museums and heritage or cultural sites, and attendance at theatrical, musical or sporting events.

Travel agencies and tour operators play a key role in organising tourism trips and ensuring highquality service and comfort for travellers. Tour operators are responsible for developing tourism products and creating packages that include transport, accommodation, excursions, insurance, and other services. They cooperate with airlines, hotels, and local partners to offer favourable conditions to clients. Travel agencies, in turn, act as intermediaries between tour operators and tourists, helping clients select the most suitable travel options according to their preferences and budgets. They provide consultations, book tours, assist with visa arrangements and insurance, and support clients throughout their journey. Owing to their work, tourists benefit from professional assistance, reduced risks, and a more relaxed and organised travel experience.

The primary indicators proposed for grouping countries are performance metrics of travel agencies and tour operators, such as value added per enterprise, turnover per enterprise, value added per employee, and turnover per employee. The performance indicators of travel agencies and tour operators in Ukraine and EU countries are presented in Tables 1 and 2. The standardised productivity indicators of travel agencies and tour operators in Ukraine and EU countries are shown in Table 3.

Table 1. Indicators of the efficiency of travel agencies in Ukraine and EU countries, 2022

Country	Absolute efficiency indicators				Productivity indicators			
	Enterprises. number	Persons employed. number	Value added. million EUR	Net turnover. million EUR	Value added per enterprise. Col. 4 : Col. 2	Turnover per enterprise. Col. 5 : Col. 2	Value added per employee. Col. 4 : Col. 3	Turnover per employee. Col. 5 : Col. 3
Ukraine	6,761	8,851	18.8	29.86	0.003	0.004	0.002	0.003
Belgium	1,070	3,962	238.69	1,784.47	0.223	1.668	0.06	0.45
Bulgaria	410	949	14.3	82.91	0.035	0.202	0.015	0.087
Czechia	C	C	C	C	C	C	C	C
Denmark	240	1,814	121.62	1,005.48	0.507	4.19	0.067	0.554
Germany	6,713	35,849	2,500.6	5,026.82	0.373	0.749	0.07	0.14
Estonia	175	601	20.76	226.45	0.119	1.294	0.035	0.377
Ireland	392	1,901	120.95	719.21	0.309	1.835	0.064	0.378
Greece	2,597	14,598	430.06	2,017.22	0.166	0.777	0.029	0.138

Table 1. Continued

Country	Absolute efficiency indicators: Enterprises. number	Persons employed. number	Value added. million EUR	Net turnover. million EUR	Productivity indicators: Value added per enterprise. Col. 4 : Col. 2	Turnover per enterprise. Col. 5 : Col. 2	Value added per employee. Col. 4 : Col. 3	Turnover per employee. Col. 5 : Col. 3
Spain	8,905	37,116	1,721.15	16,543.05	0.193	1.858	0.046	0.446
France	3,034	14,355	867.24	3,519.76	0.286	1.16	0.06	0.245
Croatia	1,602	4,702	113.77	651.04	0.071	0.406	0.024	0.138
Italy	5,104	17,013	657.7	4,119.44	0.129	0.807	0.039	0.242
Cyprus	296	1,390	64.93	99.78	0.219	0.337	0.047	0.072
Latvia	314	653	6.36	128.61	0.02	0.41	0.01	0.197
Lithuania	302	1,338	34.81	207.23	0.115	0.686	0.026	0.155
Luxembourg	60	471	22.48	108.17	0.375	1.803	0.048	0.23
Hungary	398	895	17.12	130.41	0.043	0.328	0.019	0.146
Malta	134	431	14.18	41.08	0.106	0.307	0.033	0.095
Netherlands	2,921	12,210	C	C	C	C	C	C
Austria	916	7,490	326.62	2,620.61	0.357	2.861	0.044	0.35
Poland	2,423	6,664	107.55	1,307.21	0.044	0.54	0.016	0.196
Portugal	2,235	9,216	277.23	2,297.71	0.124	1.028	0.03	0.249
Romania	1,338	3,738	85.03	506.23	0.064	0.378	0.023	0.135
Slovenia	273	627	20.35	157.6	0.075	0.577	0.032	0.251
Slovakia	668	975	14.8	113.77	0.022	0.17	0.015	0.117
Finland	280	818	39.09	265.99	0.14	0.95	0.048	0.325
Sweden	575	2,503	226.43	1,195.79	0.394	2.08	0.09	0.478

Notes: C – data are confidential
Source: compiled and calculated by the authors based on Eurostat (2025a)

Table 2. Indicators of the efficiency of tour operators in Ukraine and EU countries, 2022

Country	Absolute efficiency indicators: Enterprises. number	Persons employed. number	Value added. million EUR	Net turnover. million EUR	Productivity indicators: Value added per enterprise. Col. 4 : Col. 2	Turnover per enterprise. Col. 5 : Col. 2	Value added per employee. Col. 4 : Col. 3	Turnover per employee. Col. 5 : Col. 3
Ukraine	716	3,289	17.72	50.78	0.025	0.071	0.005	0.015
Belgium	354	2,196	178.14	1,328.32	0.503	3.752	0.081	0.605
Bulgaria	1,023	3,391	54.13	677	0.053	0.662	0.016	0.2
Czechia	C	C	C	C	C	C	C	C
Denmark	272	1,803	104.66	1,208.44	0.385	4.443	0.058	0.67
Germany	2,922	39,162	2,972.67	22,696.88	1.017	7.768	0.076	0.58
Estonia	159	319	7.88	120.76	0.05	0.759	0.025	0.379
Ireland	350	1,233	79.96	295.56	0.228	0.844	0.065	0.24
Greece	C	C	C	C	C	C	C	C
Spain	230	4,402	189.31	1,949.59	0.823	8.476	0.043	0.443
France	1,298	14,304	714.38	5,016.52	0.55	3.865	0.05	0.351
Croatia	137	523	12.01	70.39	0.088	0.514	0.023	0.135
Italy	4,653	17,055	698.94	6,239.99	0.15	1.341	0.041	0.366
Cyprus	25	70	0.93	2.84	0.037	0.114	0.013	0.041
Latvia	241	519	6.96	194.4	0.029	0.807	0.013	0.375
Lithuania	152	539	16.04	267.55	0.106	1.76	0.03	0.496
Luxembourg	11	53	1.46	7.93	0.133	0.721	0.028	0.15
Hungary	660	2,385	52.36	506.14	0.079	0.767	0.022	0.212
Malta	84	511	15.76	156.74	0.188	1.866	0.031	0.307
Netherlands	1,770	6,315	423.55	3,566.97	0.239	2.015	0.067	0.565

Table 2. Continued

Country	Absolute efficiency indicators: Enterprises. number	Persons employed. number	Value added. million EUR	Net turnover. million EUR	Productivity indicators: Value added per enterprise. Col. 4 : Col. 2	Turnover per enterprise. Col. 5 : Col. 2	Value added per employee. Col. 4 : Col. 3	Turnover per employee. Col. 5 : Col. 3
Austria	150	1,150	56.2	377.9	0.375	2.519	0.049	0.329
Poland	2,636	8,093	181.58	2,144.32	0.069	0.813	0.022	0.265
Portugal	567	1,448	43.44	368.98	0.077	0.651	0.03	0.255
Romania	1,015	3,723	95.56	579.14	0.094	0.571	0.026	0.156
Slovenia	262	768	32.04	278.91	0.122	1.065	0.042	0.363
Slovakia	495	1,562	42.99	632.56	0.087	1.278	0.028	0.405
Finland	241	692	9.64	471.57	0.04	1.957	0.014	0.681
Sweden	1,040	3,485	102.49	2,628.91	0.099	2.528	0.029	0.754

Notes: C – data are confidential

Source: compiled and calculated by the authors based on Eurostat (2025a)

Table 3. Standardised productivity indicators of travel agencies and tour operators in Ukraine and EU countries, 2022

Country	Conditional notation	Productivity indicators of travel agency activities: Value added per enterprise	Turnover per enterprise	Value added per employee	Turnover per employee	Country	Conditional notation	Productivity indicators of the tour operator activities: Value added per enterprise	Turnover per enterprise	Value added per employee	Turnover per employee
Ukraine	C_1	-1.222	-1.100	-1.696	-1.655	Ukraine	C_1	-0.759	-0.901	-1.507	-1.742
Belgium	C_2	0.354	0.643	1.025	1.490	Belgium	C_2	1.129	0.821	2.230	1.244
Bulgaria	C_3	-0.992	-0.892	-1.086	-1.064	Bulgaria	C_3	-0.649	-0.625	-0.966	-0.806
Denmark	C_4	2.389	3.285	1.353	2.222	Denmark	C_4	0.663	1.144	1.099	1.573
Germany	C_5	1.429	-0.320	1.494	-0.691	Germany	C_5	3.160	2.700	1.984	1.118
Estonia	C_6	-0.391	0.251	-0.148	0.977	Estonia	C_6	-0.660	-0.579	-0.524	0.100
Ireland	C_7	0.970	0.818	1.213	0.984	Ireland	C_7	0.043	-0.540	1.443	-0.603
Greece	C_8	-0.054	-0.290	-0.429	-0.705	Greece	–	–	–	–	–
Spain	C_9	0.139	0.842	0.368	1.462	Spain	C_8	2.394	3.032	0.361	0.424
France	C_10	0.806	0.111	1.025	0.048	France	C_9	1.315	0.874	0.705	-0.041
Croatia	C_11	-0.735	-0.679	-0.664	-0.705	Croatia	C_10	-0.510	-0.694	-0.622	-1.135
Italy	C_12	-0.319	-0.259	0.040	0.027	Italy	C_11	-0.265	-0.307	0.263	0.035
Cyprus	C_13	0.326	-0.751	0.415	-1.170	Cyprus	C_12	-0.712	-0.881	-1.114	-1.610
Latvia	C_14	-1.100	-0.675	-1.321	-0.290	Latvia	C_13	-0.743	-0.557	-1.114	0.080
Lithuania	C_15	-0.419	-0.386	-0.570	-0.586	Lithuania	C_14	-0.439	-0.111	-0.278	0.693
Luxembourg	C_16	1.443	0.785	0.462	-0.058	Luxembourg	C_15	-0.333	-0.597	-0.376	-1.059
Hungary	C_17	-0.935	-0.760	-0.899	-0.649	Hungary	C_16	-0.546	-0.576	-0.671	-0.745
Malta	C_18	-0.484	-0.782	-0.242	-1.008	Malta	C_17	-0.115	-0.061	-0.229	-0.264
Netherlands	–	–	–	–	–	Netherlands	C_18	0.086	0.008	1.541	1.042
Austria	C_19	1.314	1.893	0.274	0.787	Austria	C_19	0.624	0.244	0.656	-0.153
Poland	C_20	-0.928	-0.538	-1.039	-0.297	Poland	C_20	-0.585	-0.554	-0.671	-0.477
Portugal	C_21	-0.355	-0.027	-0.383	0.076	Portugal	C_21	-0.554	-0.630	-0.278	-0.527
Romania	C_22	-0.785	-0.708	-0.711	-0.726	Romania	C_22	-0.487	-0.667	-0.475	-1.028
Slovenia	C_23	-0.706	-0.500	-0.289	0.090	Slovenia	C_23	-0.376	-0.436	0.312	0.019
Slovakia	C_24	-1.086	-0.926	-1.086	-0.853	Slovakia	C_24	-0.514	-0.337	-0.376	0.232
Finland	C_25	-0.240	-0.109	0.462	0.611	Finland	C_25	-0.700	-0.019	-1.065	1.629
Sweden	C_26	1.579	1.075	2.432	1.687	Sweden	C_26	-0.467	0.248	-0.327	1.999

Source: calculated by the authors

Based on the Euclidean distance values for each indicator describing the productivity of travel agency and tour operator activities in Ukraine and EU countries, dendrograms were generated using Ward's method (Figs. 2-3).

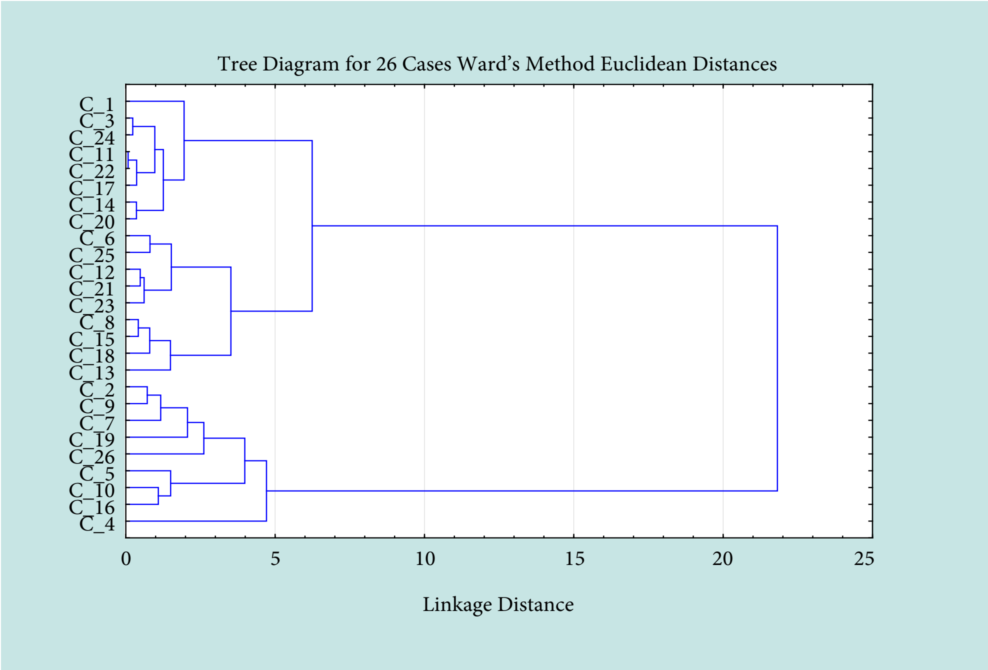

Figure 2. Dendrogram of the hierarchical grouping of Ukraine and EU countries using Ward's method based on indicators reflecting the productivity of travel agency activities, 2022
Source: constructed by the authors

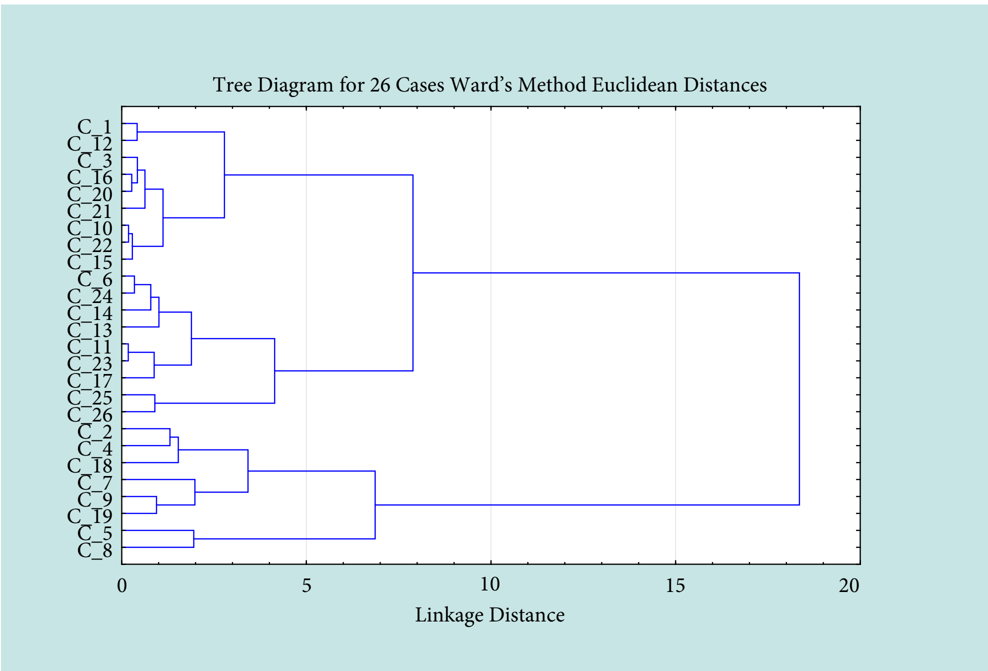

Figure 3. Dendrogram of the hierarchical grouping of Ukraine and EU countries using Ward's method based on indicators reflecting the productivity of tour operator activities, 2022
Source: constructed by the authors

Based on the results of the cluster analysis, three groups of countries can be identified according to the productivity levels of travel agency (Table 4) and tour operator (Table 5) activities.

Table 4. Characteristics of country clusters by productivity level in travel agency activities

Cluster number	Countries assigned to the cluster	Productivity level of travel agencies' activities	Cluster descriptions
1	Denmark, Luxembourg, France, Germany, Sweden, Austria, Ireland, Spain, Belgium	High	Countries with a well-developed tourism sector, and high value added and turnover per enterprise and employee in travel agency operations
2	Cyprus, Malta, Lithuania, Greece, Slovenia, Portugal, Italy, Finland, Estonia	Medium	Countries with a moderately developed but less productive travel agency sector compared to the leading group. These countries exhibit moderate income levels, stable tourism demand, and a significant presence of small enterprises
3	Poland, Latvia, Hungary, Romania, Croatia, Slovakia, Bulgaria, Ukraine	Low	Countries with low productivity in travel agency operations are reflected in limited value added and turnover indicators. The tourism sector is developing, but operational efficiency remains insufficient

Source: compiled by the authors

Table 5. Characteristics of country clusters by productivity levels in tour operator activities

Cluster number	Countries assigned to the cluster	Productivity level of tour operators' activities	Cluster descriptions
1	Germany, Spain, Belgium, Denmark, Netherlands, Ireland, France, Austria	High	Countries with high productivity in tour operator activities, characterised by substantial financial turnover and high value added
2	Sweden, Finland, Malta, Slovenia, Italy, Latvia, Lithuania, Slovakia, Estonia	Medium	Countries with moderate productivity in tour operator activities. The sector is stable but lags behind the leading group in terms of income levels and business scale
3	Luxembourg, Romania, Croatia, Portugal, Poland, Hungary, Bulgaria, Cyprus, Ukraine	Low	Countries with low productivity in tour operator activities are marked by modest financial indicators and limited resources

Source: compiled by the authors

Thus, some countries exhibit high productivity levels across sectors (travel agencies and tour operators): Germany, Spain, Belgium, Denmark, France, Austria, and Ireland. This indicates overall efficiency in their tourism sectors, where both agencies and operators demonstrate strong financial performance, developed infrastructure, and government support. Scientific research has identified a positive correlation between cultural and historical heritage and the growth of heritage and cultural tourism, particularly in Italy, France, Spain, and Portugal. The findings indicate that an increase in the number of UNESCO World Heritage sites results in a 4% rise in tourist numbers (Kutlu *et al.*, 2024). The countries identified as having high productivity in tourism-related enterprises also possess a rich cultural heritage that attracts international visitors. For example, France is renowned for its museums, architecture, and historical landmarks such as the Eiffel Tower and the Louvre. Austria is celebrated for its musical heritage and architectural sites, as well as its well-developed infrastructure for winter sports and summer recreation, all of which enhance its appeal to tourists (Advantage Austria, n.d.). In these countries, the tour operator market is highly concentrated, which facilitates more efficient resource allocation and enables the provision of competitive tourism packages. For instance, the top five tour operators in France control half of the package tour market, while the ten largest companies account for 67% of the total market. This concentration contributes to streamlining operations and reducing costs, thereby improving the overall productivity of the sector (Tarkang *et al.*, 2023; Sardi *et al.*, 2025). In addition, it is worth noting that the governments of these countries actively support the tourism industry through public funding and the implementation of strategic initiatives. For example, in Spain, tourism policy is coordinated by the State Secretariat for Trade, Tourism and Small Business, while the Spanish Tourism Institute Turespaña is tasked with promoting the country to international tourists. This centralised support structure contributes to the high performance of travel agencies and tour operators, enhancing their competitiveness in the international tourism market (Gunter *et al.*, 2024; Ion & Petre, 2024).

In contrast, countries such as Romania, Croatia, Poland, Hungary, Bulgaria, and Ukraine demonstrate low productivity in both categories, indicating a lack of efficiency in their tourism sectors. This may be attributed to smaller market sizes, lower tourist inflows, or underdeveloped infrastructure. The lowest productivity values are recorded in Ukraine, primarily due to the impact of the ongoing war following the Russian invasion. Academic literature highlights the consequences of the Russian-Ukrainian war, including widespread civilian casualties, infrastructure damage, and economic instability, all of which significantly undermine the country's appeal as a tourist destination and impair the functioning of its tourism industry (Kozlowski, 2023; Olshanska *et al.*, 2023). Other studies confirm profound changes in the structure and operation of Ukraine's tourism system as a result of the prolonged conflict (Tomej & Bilynets, 2024).

Countries exhibit varying productivity levels across different categories, such as Luxembourg (which demonstrates high productivity in travel agency activities but low productivity in tour operator operations), Sweden (which shows high productivity in travel agency activities but moderate productivity in tour operator operations), and Portugal (which displays moderate productivity in travel agency activities but low productivity in tour operator operations). It is noteworthy that some European countries may have limited capacity to provide financial subsidies to tour operators, as governments may prioritise budget allocations to other sectors such as infrastructure, education, or healthcare. In addition, state aid within the EU is regulated by stringent rules designed to prevent unfair competition. Research findings by T. Malatinec (2024) indicate that France and Spain are among the leading countries actively utilising officially reported state aid, whereas Luxembourg and Portugal have not employed such support within the tourism sector. This may be attributed to Luxembourg's lack of dependence on tourism, given its small tourism sector and a national economic focus on financial services. Portugal, meanwhile, places greater emphasis on private investment and alternative mechanisms for promoting tourism – such as European grants – rather than direct state aid. The absence of reliable statistical data and the limited scale of Luxembourg's tourism market represent significant constraints for research (Astike *et al.*, 2024).

Thus, most countries demonstrate consistent productivity levels across both categories, reflecting a stable level of development in the tourism market. However, in certain cases, discrepancies between the productivity of travel agencies and tour operators may arise due to specific market conditions, differing business models, or the underlying economic structure of the tourism sector (for instance, the more prominent role of independent travel agencies versus largescale tour operators). To determine whether travel agencies and tour operators are more strategically oriented towards domestic or international tourism, a suitable metric may be employed – namely, the ratio of organised domestic to international tourism trips. This indicator enables an assessment of national tourism priorities: a higher number of international trips relative to domestic ones suggests a stronger orientation towards international tourism; conversely, a predominance of domestic travel indicates a focus on promoting internal tourism, often supported by public institutions and industry stakeholders. Based on this ratio, two categories of countries can be identified: those in which international tourism predominates and those where domestic tourism is more significant (Table 6).

Table 6. Indicators of the number of international and domestic tourism trips in EU countries, 2022

Country	Number of international tourism trips	Number of domestic tourism trips	Total number of tourism trips	Share of international tourism trips (%)	Share of domestic tourism trips (%)
Belgium	13,498,234	4,622,248	18,120,482	74	26
Bulgaria	879,455	3,434,713	4,314,168	20	80
Czechia	6,826,441	26,148,995	32,975,436	21	79
Denmark	6,043,213	12,156,442	18,199,655	33	67
Germany	86,623,140	135,068,582	221,691,722	39	61
Estonia	1,119,496	2,639,870	3,759,366	30	70
Ireland	7,460,294	10,517,093	17,977,387	41	59
Greece	939,366	5,990,073	6,929,439	14	86
Spain	13,588,870	124,602,722	138,191,592	10	90
France	26,790,132	202,475,552	229,265,684	12	88
Croatia	1,351,328	3,148,238	4,499,566	30	70
Italy	9,330,779	38,008,674	47,339,453	20	80
Cyprus	1,234,615	1,689,154	2,923,769	42	58
Latvia	1,303,207	2,828,190	4,131,397	32	68
Lithuania	1,919,427	3,595,009	5,514,436	35	65
Luxembourg	2,818,099	165,180	2,983,279	94	6
Hungary	5,516,318	10,612,325	16,128,643	34	66
Malta	568,160	369,000	937,160	61	39
Netherlands	23,145,692	21,489,855	44,635,547	52	48
Austria	14,040,577	14,652,513	2,869,3090	49	51

Table 6. Continued

Country	Number of international tourism trips	Number of domestic tourism trips	Total number of tourism trips	Share of international tourism trips (%)	Share of domestic tourism trips (%)
Poland	11,741,604	51,701,833	63,443,437	19	81
Portugal	2,248,981	16,765,837	19,014,818	12	88
Romania	1,475,106	16,820,104	18,295,210	8	92
Slovenia	3,160,974	2,772,562	5,933,536	53	47
Slovakia	3,302,534	7,142,078	10,444,612	32	68
Finland	6,190,196	27,103,670	33,293,866	19	81
Sweden	15,268,834	62,400,828	77,669,662	20	80

Source: compiled and calculated by the authors based on Eurostat (2025b)

By comparing the productivity levels of tourism enterprises with the orientation of tourism flows, clusters of EU countries may be identified based on the similarity of their performance in organising heritage and cultural tourism trips (Table 7). The results of grouping EU countries using the proposed matrix – which takes into account the distribution of tourism enterprises into travel agencies and tour operators – are presented in Tables 8 and 9.

Table 7. Interpretation of the matrix for grouping EU countries by the productivity level of tourism enterprises in the organisation of heritage and cultural tourism trips

Predominance of the share of tourism trips in a given direction	*International tourism*	Citizens travel abroad independently; the activities of tourism enterprises are inefficient	Tourism enterprises are partially involved in organising international trips	High level of international tourism organisation through tourism enterprises
	Domestic tourism	Tourists travel without using organised services; the market for package trips is weak	Tourist enterprises are moderately active; domestic trips are partially organised	High level of domestic tourism organisation through tourism enterprises
		Low	*Medium*	*High*
		Productivity level of tourism enterprises' activities		

Source: proposed by the authors

Table 8. Matrix grouping of EU countries by the productivity level of travel agencies in the organisation of heritage and cultural tourism trips

Prevalence of the share of tourism trips in the direction	*International tourism*	–	Malta Slovenia	Belgium Luxembourg
	Domestic tourism	Poland Latvia Hungary Romania Croatia Slovakia Bulgaria	Cyprus Lithuania Greece Portugal Italy Finland Estonia	Denmark France Germany Sweden Austria Ireland Spain
		Low	*Medium*	*High*
		Productivity level of travel agency activities		

Source: compiled by the authors

Table 9. Matrix grouping of EU countries by the productivity level of tour operatorszzz in the organisation of heritage and cultural tourism trips

Prevalence of the share of tourism trips in the direction	*International tourism*	Luxembourg	Malta Slovenia	Belgium Netherlands
	Domestic tourism	Romania Croatia Portugal Poland Hungary Bulgaria Cyprus	Sweden Finland Italy Latvia Lithuania Slovakia Estonia	Germany Spain Denmark Ireland France Austria
		Low	*Medium*	*High*
		Productivity level of tour operator activities		

Source: compiled by the authors

Productivity level of travel agency activities

Based on the grouping results of EU countries, it can be concluded that domestic tourism is a key driver of high productivity for travel agencies and tour operators in leading EU states. As a result of the COVID-19 pandemic, domestic tourism has become significantly more important across the European Union. Restrictions on international travel, quarantine measures, and safety concerns prompted many Europeans to holiday within their own countries. Domestic tourism has therefore become a vital part of the economy, supporting local tourism businesses and reducing reliance on foreign visitors. Countries such as Germany, France, Italy, and Spain have actively fostered domestic tourism through investment in promotion, infrastructure, and the development of new destinations (Falk *et al.*, 2022). The situation in Ukraine is even more critical. In addition to the pandemic, the country continues to face the devastating effects of war. The war with Russia has caused a sharp decline in international tourism while simultaneously increasing interest in domestic travel, driven by security concerns and restrictions on leaving the country (Shpak *et al.*, 2023). The proposed matrix offers a tool for evaluating the effectiveness of travel agencies and tour operators in organising both domestic and international tourism. This distinction provides insight into which countries are more dependent on domestic tourism and which rely more heavily on international flows.

CONCLUSIONS

As a result of the study, EU countries were clustered based on the productivity levels of travel agencies and tour operators. The analysis identified three main groups: high, medium, and low productivity. Countries with high productivity in both categories (Germany, Spain, Belgium, Denmark, France, Austria, Ireland, etc.) are characterised by high value added per enterprise and employee, a significant share of international tourism, and well-developed tourism infrastructure. High productivity is associated with the adoption of modern technologies, effective business models, and substantial investment in the industry. Countries with medium productivity (Italy, Finland, Lithuania, Greece, Portugal, etc.) possess a developed tourism sector but lag behind the leading nations due to less efficient resource allocation, limited investment, and lower levels of infrastructure development. Countries with low productivity (Romania, Croatia, Poland, Hungary, Bulgaria, etc.) demonstrate inefficiencies in the operation of the tourism sector. This may be attributed to a limited market, lower tourist numbers, or underdeveloped infrastructure. The situation in Ukraine was analysed separately and was found to correspond with the group of lowproductivity countries in terms of travel agencies and tour operators.

Most countries exhibit stable productivity across both categories, reflecting a consistent level of tourism market development. However, some countries reveal discrepancies between the productivity levels of travel agencies and tour operators, which may be explained by market characteristics, business strategies, or differing tourism models (e.g., a more prominent role for individual agencies over large-scale operators). A matrix-based method was proposed to determine the focus of travel agencies and tour operators on either domestic or international tourism and to assess their effectiveness in these areas. This approach enabled the classification of EU countries according to the productivity of their tourism enterprises in the organisation of heritage and cultural tourism trips for both international and domestic markets. Based on the results, it was concluded that domestic tourism constitutes a key factor in the high productivity of tourism enterprises in the leading EU countries. Future research should focus on developing practical recommendations to enhance the efficiency of tourism enterprises, respond to modern challenges, and integrate new technologies to strengthen the tourism sector's competitiveness.

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REFERENCES

[1] Advantage Austria. (n.d.). *Outbound tourism to Austria. Overview*. Retrieved from https://www.advantageaustria.org/ua/zentral/branchen/tourismus-nach-oesterreich/overview/Ueberblick.en.html.

[2] Astike, K., Borges, A.P., Skvarciany, V., & Vieira, E. (2024). Do cultural activities and happiness matter to the tourism sector? *Economics and Culture*, 21(1), 93-104. doi: 10.2478/jec-2024-0007.

[3] Coelho, A., & Castillo-Girón, V.M. (2020). The medium of exchange in mergers and acquisitions: The cases of travel agencies and tour operators. *Administrative Sciences*, 10(4), article number 97. doi: 10.3390/admsci10040097.

[4] Eurostat. (2025a). *Enterprises by detailed NACE Rev. 2 activity and special aggregates*. doi: 10.2908/SBS_OVW_ACT.

[5] Eurostat. (2025b). *Trips by duration, purpose, and leading destination*. doi: 10.2908/TOUR_DEM_TTTOT.

[6] Falk, M.T., Hagsten, E., & Lin, X. (2022). Domestic tourism demand in the North and the South of Europe in the Covid-19 summer of 2020. *The Annals of Regional Science*, 69(2), 537-553. doi: 10.1007/s00168-022-01147-5.

[7] Franczak, I., & Bakota, D. (2024). Tourism business management regarding earnings management by travel agencies during disease threats – evidence from Poland. *Journal of Business Economics and Management*, 25(4), 774-788. doi: 10.3846/jbem.2024.22029.

[8] Grigorescu, A., Lincaru, C., Pirciog, S., & Chitescu, R.-I. (2021). Mapping post-crisis European job growth in travel agencies and tour operator reservation services. *Economic Research-Ekonomska Istraživanja*, 34(1), 2906-2934. doi: 10.1080/1331677X.2020.1860110.

[9] Gunter, U., Smeral, E., & Zekan, B. (2024). Forecasting tourism in the EU after the COVID-19 crisis. *Journal of Hospitality and Tourism Research*, 48(5), 909-919. doi: 10.1177/10963480221125130.

[10] Harb, G., & Bassil, C. (2022). Regional growth, domestic and foreign tourism in NUTS regions: New insights from the old continent. *Journal of Travel Research*, 61(2), 279-298. doi: 10.1177/0047287520979673.

[11] Ion, R.A., & Petre, I.L. (2024). Influence analysis of different factors from the tourism sector on rural gross value added: Cross-section analysis at the EU level. *Sustainability*, 16(20), article number 8997. doi: 10.3390/su16208997.

[12] Kozlowski, A.R. (2023). The war and tourism: Security issues and business opportunities in the shadow of the Russian war against Ukraine. *Quality and Quantity*. doi: 10.1007/s11135-023-01762-0.

[13] Kutlu, D., Zanbak, M., Soycan, S., Kasalak, M.A., & Aktaş Çimen, Z. (2024). The influence of world heritage sites on tourism dynamics in the EU 27 nations. *Sustainability*, 16(20), article number 9090. doi: 10.3390/su16209090.

[14] Malatinec, T. (2024). European Union legal framework of state aid in cultural tourism and the use of notified aid by member states. *Juridical Tribune – Review of Comparative and International Law*, 14(4), 620-635. doi: 10.62768/TBJ/2024/14/4/06.

[15] Nikas, I.A. (2024). Spatial analysis of tourist routes offered by travel agencies and some overtourism issues: The case of Crete. In V. Katsoni & G. Cassar (Eds.), *Recent advancements in tourism business, technology and social sciences (IACuDiT 2023)* (pp. 623-638). Cham: Springer. doi: 10.1007/978-3-031-54338-8_36.

[16] Olshanska, O., Puzyrova, P., & Shevchenko, I. (2023). The tourist industry of Ukraine in the post-war period: Key directions of recovery and factors of influence in the European vector of development. *Journal of Strategic Economic Research*, 24(6), 99-107. doi: 10.30857/2786-5398.2023.6.10.

[17] Rodríguez, P., & García, J.S. (2022). Use of influencers in the Spanish tourism companies' digital marketing. *Cuadernos. Info*, 51, 200-222. doi: 10.7764/cdi.51.27743.

[18] Sánchez-Dávila, E., & García, L.Y. (2025). Does the origin of tourism matter for poverty reduction? Evidence from Peruvian's department, 2003-2022. *Journal of Policy Research in Tourism, Leisure and Events*, 1-18. doi: 10.1080/19407963.2024.2448447.

[19] Sardi, A., Rizzi, A., & Sorano, E. (2025). Economic impact analysis of mega events for sustainable tourism: Insights from the Giro d'Italia and Tour de France. *Administrative Sciences*, 15(2), article number 35. doi: 10.3390/admsci15020035.

[20] Shpak, N., Kulyniak, I., Novakivskyi, I., & Oleksiv, I. (2023). Clusterization in tourism development level's assessment of regions: Example of Ukraine. *Journal of Tourism and Services*, 14(26), 45-56. doi: 10.29036/jots.v14i26.444.

[21] State Statistics Committee of Ukraine. (2010). *Classification of types of economic activity. DK 009:2010*. Kyiv: State Consumer Standard of Ukraine.

[22] Tarkang, M.E., Adedoyin, F.F., & Bekun, F.V. (2023). an investigation into the role of tourism growth, conventional energy consumption, and real income on ecological footprint nexus in France. *International Journal of Renewable Energy Development*, 12(1), 46-54. doi: 10.14710/ijred.2023.43246.

[23] Tomej, K., & Bilynets, I. (2024). Large-scale tourism transformations through regeneration: A living systems perspective on tourism developments in Ukraine during the war. *Annals of Tourism Research*, 109, article number 103856. doi: 10.1016/j.annals.2024.103856.

[24] Veríssimo, I., & Costa, R. (2021). Risk management in travel agencies and tour operators in Portugal. *Journal of Tourism and Development*, 36(2), 91-100. doi: 10.34624/rtd.v36i2.26013.

[25] Zaninović, V., & Host, A. (2021). Determinants of operating revenues: Travel agencies vs tour operators in the European Union. In G. Karanovic, P. Polychronidou, A. Karasavvoglou & H. Maskarin Ribaric (Eds.), *Tourism management and sustainable development. Contributions to economics* (pp. 63-69). Cham: Springer. doi: 10.1007/978-3-030-74632-2_5.

Олег Карий
Доктор економічних наук, професор
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
https://orcid.org/0000-0002-1305-3043

Ігор Кулиняк
Кандидат економічних наук, доцент
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
https://orcid.org/0000-0002-8135-4614

Соломія Огінок
Кандидат економічних наук, доцент
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
https://orcid.org/0000-0001-5462-5362

Юлія Бондаренко
Кандидат економічних наук, доцент
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
https://orcid.org/0000-0002-2362-7629

Співпраця між туристичними агентами та туристичними операторами у сфері організації історико-культурних туристичних поїздок у країнах Європейського Союзу

Анотація. Метою дослідження було формування кластерної структури ринку та визначення тенденцій розвитку туристичної сфери на основі оцінювання продуктивності діяльності туристичних агентів і туристичних операторів у країнах Європейського Союзу та Україні у сфері організації історико-культурних міжнародних та внутрішніх туристичних поїздок. Для аналізу використано комплекс методів, зокрема кластерний аналіз, статистичні методи, стандартизацію даних, матричний метод, порівняльний аналіз. Для оцінювання продуктивності діяльності туристичних компаній розраховано такі показники, як додану вартість на одне підприємство, оборот на одне підприємство, додану вартість на одного працівника та оборот на одного працівника. Застосування ієрархічної кластеризації дозволило розділити країни на три групи за рівнем продуктивності діяльності туристичних агентів та туристичних операторів: високий, середній і низький. Україну віднесено до групи з низькою продуктивністю діяльності як туристичних агентів, так і туристичних операторів. Виявлено, що більшість країн ЄС демонструють стабільну продуктивність діяльності обох категорій туристичних компаній, що вказує на узгоджений рівень розвитку туристичного ринку. Проте деякі країни мають розбіжності між рівнем продуктивності діяльності туристичних агентів та туристичних операторів, що пояснюється особливостями ринку, стратегіями бізнесу та економічною моделлю туризму. Для виявлення напряму фокусу туристичних агентів та туристичних операторів на організацію внутрішніх чи міжнародних туристичних поїздок, а також визначення ефективності їх роботи на цих напрямах, запропоновано скористатись показником, який відображає співвідношення кількості організованих внутрішніх та міжнародних туристичних поїздок. Матричним методом за допомогою співставлення рівня продуктивності діяльності туристичних підприємств з напрямом орієнтації туристичних поїздок, сформовано кластери країн ЄС за подібністю продуктивності їх діяльності у сфері організації історико-культурних туристичних поїздок. За результатами групування країн ЄС зроблено висновок, що внутрішній туризм є ключовим чинником високої продуктивності діяльності туристичних компаній у провідних країнах ЄС. Результати дослідження можуть бути використані для розроблення стратегій підвищення ефективності діяльності туристичних підприємств, зокрема шляхом оптимізації бізнес-моделей, залучення іноземних туристів та організації внутрішніх туристичних поїздок

Ключові слова: туристичне підприємство; історико-культурна спадщина; ефективність; продуктивність; туристичний ринок; міжнародний та внутрішній туризм

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Viacheslav Makedon*
Doctor of Economics, Associate Professor
Oles Honchar Dnipro National University
49010, 72 Nauky Ave., Dnipro, Ukraine
https://orcid.org/0000-0001-8131-0235

Dmytro Koptilyi
PhD in Economics, Deputy Director
Flight Control Limited Liability Company
49170, 115 Nauky Ave., Dnipro, Ukraine
https://orcid.org/0009-0004-7390-8746

Digital transformation and artificial intelligence as factors in the economic recovery of enterprises following armed conflicts

Abstract. Digital transformation and the introduction of artificial intelligence present new opportunities for the recovery and gradual development of economic activity in small enterprises, enhancing their ability to respond to post-war challenges and utilise innovative technological solutions more effectively. The purpose of the study was to assess the impact of digital tools and artificial intelligence on the economic recovery of small enterprises in the post-conflict period. To collect data, a structured online questionnaire was developed, comprising six sections addressing various aspects of digital transformation in small enterprises. The questions covered the extent of digital technology adoption, the types of tools utilised, key barriers to digitalisation, and the impact of digital transformation on the economic recovery of enterprises. Correlation and regression analysis of the responses enabled an evaluation of the statistical relationship between digital technology adoption and the recovery of economic activity in businesses. The majority of the 50 small retail enterprises surveyed in the Kyiv region actively employ digital tools, including online stores, mobile applications, artificial intelligence, and cloud technologies, indicating a high level of adaptation to contemporary business conditions. However, the study uncovers that innovative solutions such as ERP systems and blockchain technology are implemented less frequently, suggesting the need for resources and technical support. Correlation analysis confirmed a moderate positive relationship between the extent of digital technology adoption and the economic recovery of enterprises, reinforcing the importance of innovative solutions in ensuring business stability and development in times of economic challenges. The findings of this study may be valuable to governmental bodies and state institutions involved in shaping policies to support the digitalisation of small businesses and enterprises considering investments in new technologies

Keywords: cloud technologies; blockchain technologies; mobile applications; chatbots; information technologies

INTRODUCTION

In 2025, small businesses face challenges, including escalating conflicts, military actions, economic instability, market demands, and the need to ensure sustainable growth. As many businesses are forced to suspend operations due to warfare, the issue of restoring their economic activity becomes paramount. However, these challenges also present new opportunities for transformation through the adoption of digital technologies, including artificial intelligence (AI). Gradually, technological advancements are reshaping conventional business approaches, providing

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*Corresponding author

small enterprises with new tools to enhance their efficiency, particularly in the face of uncertainty in internal and external environments and in emerging markets. In the post-conflict period, solutions based on digital tools and AI contribute to the accelerated recovery of businesses by facilitating demand forecasting, optimising supply chains, and developing personalised customer interaction strategies. Moreover, the accessibility of these technologies enables even small businesses with limited resources to implement them, fostering equal opportunities for recovery and development. The integration of such technologies allows small enterprises to mitigate the consequences of economic shocks and lays the foundation for sustainable growth in a new economic reality.

According to Eurostat (2025), only 8% of businesses in the EU had adopted AI technologies in their operations in 2023, while more than 30% of large companies, primarily in the information and communication sector, had implemented them. This indicates that, although these technologies are gaining traction, their adoption remains relatively limited across businesses. IT companies, telecommunications providers, and other organisations engaged in software and hardware development, data security solutions, and e-commerce are typically the first to implement technological innovations and automate processes. Consequently, these enterprises have greater opportunities to integrate AI to enhance service efficiency and operational effectiveness, including through the implementation of energy efficiency management (Makedon *et al*., 2019).

The relevance of digital transformation and AI adoption in the context of post-conflict economic recovery lies in their potential to optimise processes, improve efficiency, and accelerate business restoration. Research on digital transformation and its role in business recovery after crises, particularly military conflicts, explored various aspects of this complex issue. For instance, V. Voronkova *et al*. (2024) examined the conceptual foundations for developing human resource strategies in industrial enterprises. Their study focused on improving management efficiency in the context of complex socio-technological interactions within industrial companies. Furthermore, R. Stepanenko (2024) highlighted the priorities and risks associated with digital transformation. His study is closely intertwined with the work by O. Chorna (2022), who focused on the regulatory aspects of transitioning businesses to the digital economy. O. Chorna emphasised the need to refine legislative frameworks to support digital initiatives.

N. Yevtushenko & D. Stetsenko (2024) examined the impact of the war in Ukraine on the business environment, highlighting the opportunities that digitalisation offers businesses even in times of crisis. Their findings are supported by V. Tyshchenko *et al*. (2024), who analysed the role of digital technologies in the recovery of affected regions, demonstrating their importance in the development of new infrastructures. H. Mykhalchenko *et al*. (2023) complemented these findings with research on crisis management in wartime conditions. Meanwhile, N. Kholiavko *et al*. (2024) explored the impact of innovative digital technologies, such as programming interfaces, the Internet of Things, blockchain, and cloud computing, on the recovery of Ukrainian universities, emphasising the role of artificial intelligence in the personalisation of learning and the improvement of educational services.

C. Li & Y. Wang (2024) argued that the level of corporate governance determines the extent to which digital transformation contributes to business resilience; the higher the level of corporate governance, the greater the impact of digital transformation on resilience. G. White & S. Liptak (2024) investigated the use of artificial intelligence in the development of business continuity plans for small enterprises. Their conclusions align with the predictive asset maintenance model proposed by J Chen *et al*. (2021) for crisis scenarios, particularly in the post-pandemic period following Covid-19. Furthermore, R. Martín-Rojas *et al*. (2023) underscored the importance of digitalisation tools in supporting the resilience of small and medium-sized enterprises, particularly in the aftermath of the pandemic.

Thus, studies on digital transformation in businesses encompassed a wide range of aspects, from managerial and regulatory considerations to innovative technologies. These studies provided insights into how digital solutions contribute to recovery and long-term business resilience in times of crisis. However, gaps remain concerning the use of digitalisation tools and artificial intelligence to restore small enterprises' economic activity, specifically in the aftermath of military conflicts. Accordingly, the purpose of this study is to assess the impact of digital tools and artificial intelligence on the recovery of small enterprises' economic activity during and after military conflicts. The research objectives are as follows:

1. To describe the current state of digital transformation worldwide, including its key advantages and limitations.
2. To assess the level of adoption of digital tools and artificial intelligence among small enterprises in the Kyiv region of Ukraine.
3. To determine the relationship between the adoption of digital technologies and the recovery of economic activity among enterprises in the Kyiv region of Ukraine.

MATERIALS AND METHODS

For this study, ten small enterprises engaged in retail and wholesale trade in the Kyiv region were selected. The names of these enterprises are not disclosed to ensure the confidentiality of the collected data. This measure is necessary to uphold ethical research standards, protect the commercial information of the enterprises, and prevent external factors from influencing their operations. Instead, the data were analysed in an aggregated manner, allowing the study to focus on identifying general trends and challenges in the retail and wholesale trade sectors in the Kyiv region without compromising the rights of the research participants. The selection of small enterprises was driven by their ability to rapidly adapt to changes and implement new digital technologies and artificial intelligence, which is crucial for business recovery following military conflicts. The Kyiv region was chosen due to its economic importance, the presence of a large number of small enterprises, and the diversity of conditions, which enables a representative sample from different parts of the region. Retail and wholesale trade were selected for their vital role in post-conflict economic recovery, as these sectors directly impact the supply of goods, price stability, and the provision of essential consumer needs. Moreover, these industries are actively adopting digital technologies that enhance operational efficiency in post-conflict recovery settings.

A structured online questionnaire comprising 16 questions was developed to assess the use of digital technologies and artificial intelligence in enterprises following the cessation of active hostilities in early 2022 (Table 1). The respondents in this study were primarily individuals in managerial positions within small enterprises, including business owners, directors, and mid-level managers. Contact with respondents was established through official company communication channels, such as email. Prior to participation, all respondents were informed about the study's objectives, the conditions of their participation, and the fact that their responses would be used exclusively in an aggregated format. No information that could identify individual respondents or enterprises will be disclosed in the public domain. This approach ensures adherence to confidentiality and ethical principles in research. Respondents were asked to assess the level of adoption of various digital technologies, including online stores, Customer Relationship Management (CRM) systems, Enterprise Resource Planning (ERP) systems, process automation, artificial intelligence, chatbots, and mobile applications.

Table 1. Questionnaire for surveying enterprises on the use of digital technologies and artificial intelligence for the recovery of economic activity following military conflicts

No.	Question	Answer
	Information about enterprises	
1	Company name	
2	Number of employees	
3	Field of activity (wholesale or retail trade)	
4	Location (city, region)	
	Digital technologies at the enterprise	
1	Assess the level of use of digital technologies at the enterprise	1 (low) / 2 / 3 / 4 / 5 (high)
2	How often are digital technologies used in your business?	1 (never) / 2 / 3 / 4 / 5 (often)
3	Which of the following digital technologies do you use at your company? (Select all that apply)	Online stores CRM systems ERP systems Artificial intelligence Chatbots Mobile applications Blockchain Cloud technologies Others (specify)
4	How do you assess the impact of digital technologies on the efficiency of your enterprise	1 (minimum) / 2 (medium) / 3 (maximum)
5	What impact did digital technologies have on your company in the process of economic recovery after the war?	1 (insignificant) / 2 / 3 / 4 / 5 (significant)
	Knowledge and training	
1	What is the level of digital knowledge of your employees?	1 (low) / 2 / 3 / 4 / 5 (high)
2	Do you conduct training for employees on the implementation of new digital technologies?	Yes No
	Factors of implementation of digital technologies	
1	Which of the following factors contributed to the implementation of digital technologies at your company? (Select all that apply)	Market needs Competition Cost reduction Increasing efficiency Improving the quality of customer service Others (specify)

Table 1. Continued

No.	Question	Answer
	Problems of implementing digital technologies	
1	What problems arose during the implementation of digital technologies? (Select all that apply)	High implementation costs Insufficient level of knowledge and qualifications of employees Technical problems (incompatibility, failures) The need for constant support and updating Lack of necessary resources Others (specify):
	Prospects for the use of digital technologies	
1	How do you assess the prospects for the use of digital technologies in your field of activity?	1 (unprofitable) / 2 / 3 / 4 / 5 (profitable)
	Additional comments	
	Your suggestions or comments for improving the process of implementing digital technologies in the enterprise	

Source: developed by the authors

In addition, the questionnaire included questions on the effectiveness of implementing these technologies and their impact on business recovery after the conflict. It also examined the factors influencing the adoption of digital technologies and the challenges faced by enterprises. Analysis of Variance (ANOVA) was applied to assess differences between groups of enterprises based on their level of digital technology and artificial intelligence usage (Ståhle & Wold, 1989). The study adhered to the ethical and data protection guidelines outlined by the European Commission (2021). Accordingly, respondents were provided with clear assurances that their data would be used exclusively within the scope of this study and would not be disseminated or used in other contexts. Each participant was informed that their personal data would not be shared with third parties and that the survey results and collected data would be used solely for the preparation of this manuscript. This ensured a high level of confidentiality and compliance with ethical standards.

At the initial stage, the primary research objectives were defined, the study design was developed, and data collection instruments were prepared. A correlational method was chosen to analyse the impact of digital technologies and artificial intelligence on the recovery of economic activity in enterprises following military conflicts. It was decided to employ ANOVA to examine statistical differences between groups of enterprises concerning their adoption of digital technologies and artificial intelligence and their impact on the recovery process. Moreover, the questionnaire structure was developed for data collection.

During the second stage of the study, data were gathered through a survey method. Each enterprise completed an online questionnaire in which respondents assessed the extent of their use of digital technologies, including artificial intelligence and their impact on business recovery following military conflicts. The questionnaire included questions addressing various aspects of digital technology usage, the factors driving adoption, the challenges faced by enterprises, and plans for digital transformation.

At the final stage, an analysis of the collected data was conducted. A correlation-variance analysis using ANOVA was performed to evaluate statistically significant differences among enterprises based on their level of digital technology and artificial intelligence adoption and their impact on business recovery. To assess respondents' perceptions of digital technology implementation, a five-point Likert scale was employed, allowing respondents to rate the level of digital technology adoption and its impact on business recovery on a scale from 1 to 5 (1 – "minimal", 5 – "maximum") (de Winter & Dodou, 2010).

RESULTS

As of 2025, digital technologies have become a key factor in enterprise development, transforming conventional approaches to business process management. They serve not only as tools for automation but also as platforms for creating new opportunities. The survey results are presented in Table 2.

Digital transformation means the introduction of digital technologies to transform business processes and services from a traditional, non-digital format to a digital one. This includes transferring data to the cloud, using technological devices and tools for communication and collaboration, and automating processes. Global digital transformation spending is projected at USD 3 billion in 2025, and by 2027, this figure could reach USD 3.9 trillion (Fig. 1). The main driver of the growth of digital transformation is the COVID-19 pandemic, which greatly accelerated the pace of digital change in companies around the world in 2020. Although the pandemic is over, remote work has remained and even gained popularity in many organisations, which was an additional impetus for further digitalisation.

Table 2. Survey results

Enterprise	Enterprise 1	Enterprise 2	Enterprise 3	Enterprise 4	Enterprise 5	Enterprise 6	Enterprise 7	Enterprise 8	Enterprise 9	Enterprise 10
Level of digital technology adoption (1-5)	4	3	5	4	5	4	5	3	4	4
Frequency of digital technology usage (1-5)	4	3	5	2	4	3	5	2	4	5
Types of digital technologies employed (e-commerce platforms; CRM systems; ERP; artificial intelligence; chatbots; mobile applications; blockchain; cloud technologies)	CRM systems; e-commerce platforms; mobile applications; chatbots; cloud technologies	ERP systems; artificial intelligence; cloud technologies	artificial intelligence; CRM systems; e-commerce platforms; chatbots; cloud technologies	CRM systems; chatbots; artificial intelligence; cloud technologies	e-commerce platforms; artificial intelligence; mobile apps; blockchain; cloud technologies	ERP systems; artificial intelligence; chatbots; cloud technologies	artificial intelligence; online stores, blockchain; CRM systems; cloud technologies	CRM systems; mobile applications; artificial intelligence; cloud technologies	e-commerce platforms; ERP systems; CRM systems; chatbots; artificial intelligence; cloud technologies	e-commerce platforms; artificial intelligence; chatbots; cloud technologies
Perceived impact of digital technologies on enterprise efficiency (1-3)	3	2	3	1	3	2	3	1	3	3
Impact of digital technologies on economic recovery (1-5)	5	4	5	3	4	3	5	2	4	5
Level of knowledge about digital technologies (1-5)	4	3	5	2	4	4	5	3	4	5
Digital learning (Yes/No)	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	No

Table 2. Continued

Enterprise	Enterprise 1	Enterprise 2	Enterprise 3	Enterprise 4	Enterprise 5	Enterprise 6	Enterprise 7	Enterprise 8	Enterprise 9	Enterprise 10
Factors driving digital technology adoption	Market demand; competition; innovation	Process optimisation; service improvement; reduction of human error	Innovation; expansion of customer base; data management simplification	Cost reduction; service efficiency; enhanced competitiveness	Process enhancement; increased efficiency; need for rapid solutions	Improved communication; competition; workflow enhancement	Innovation; service improvement; expansion of customer base	Management simplification; need for data analysis; market expansion	Need for digitalisation; financial process improvement; cost reduction	Enhanced competitiveness; market expansion; service improvement
Challenges in digital technology adoption	Integration costs; lack of skilled personnel; absence of governmental support	High implementation costs; limited access to high-speed internet	Technical difficulties; shortage of specialists	Increased costs; insufficient experience; challenges in integrating new technologies	System integration; lack of technical resources	Market instability; need for infrastructure upgrades	Implementation costs; integration with existing systems; data security concerns	Low personnel qualifications; Internet connectivity issues	Integration costs; technical difficulties	Implementation costs; integration complexity; data security concerns
Prospects of digital technologies (1-5)	5	4	5	3	4	4	5	3	5	5
Additional comments	Increased technical support is required	More active monitoring is needed	Assistance with data analysis is required	Additional support is necessary	Staff training is essential	Process stability is required	Technical support is needed for further development	Assistance is required for adaptation	Consideration of additional resources is necessary	Expansion of technical support is crucial

Source: developed by the authors

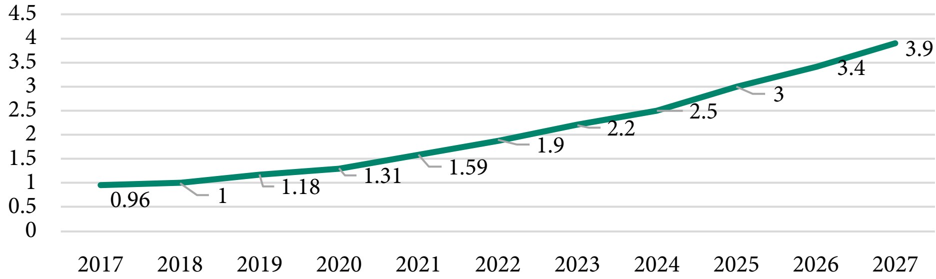

Figure 1. Global spending on digital transformation technologies and services
Notes: period – from 2017 to 2027; in USD
Source: compiled by the authors based on A. Sherif (2024)

Other factors include growing demand from consumers and the need to compete with other businesses. In general, the introduction of digital transformation technologies allows organisations to become more flexible in response to changes in the market and promotes innovation, which increases their resilience to external challenges. For a substantial part of entrepreneurs, the war was a kind of impetus for rethinking and improving tools for optimising and automating business processes. Many enterprises that previously managed with minimal technical means began to consider the need to automate and ensure the sustainability of their business processes for the first time, given the new challenges associated with threats of shelling, damage to infrastructure, and regular power outages. Table 3 systematises the advantages and potential risks of using digital technologies in small businesses.

The use of digital technologies allows small businesses to seriously improve the efficiency of their operations, reduce costs, and enhance customer service. Technologies such as artificial intelligence, cloud platforms, and CRM systems help automate routine processes, and blockchain provides a high level of security and transparency in financial transactions. Thereby, the implementation of such technologies can be complex and require considerable financial and human resources, as well as a careful approach to ensuring data security and adapting to specific business needs.

A study conducted by International Business Machines Corporation (2022) showed global trends in the introduction of artificial intelligence in business practice. Globally, 35% of companies have already integrated AI into their operations, and 44% of them plan to implement these technologies in the future. This shows that artificial intelligence is gradually becoming the standard in some industries (automotive industry, financial sector), providing not only increased efficiency but also improved strategic decision-making.

According to International Business Machines Corporation (2022), there is also a division by company size: more than 50% of large companies with more than 5,000 employees already use AI, which is a clear indicator that large corporations are actively implementing these technologies to optimise business processes. 25% of small businesses also use artificial intelligence, although in smaller volumes, which indicates the availability of technologies even for small businesses. AI technologies are most often used in manufacturing, information services, and healthcare (12%). In construction and retail, this figure is lower – only 4%.

In 2025, in Ukraine, due to the long war, small businesses act as a certain driver of economic stability and state development. One of the key areas of adaptation and survival of enterprises in these conditions is the introduction of digital technologies that allow not only to reduce costs and increase efficiency but also to ensure flexibility and competitiveness in the market. Figure 2, based on Table 2, shows the frequency of use of digital technologies by small enterprises of the Kyiv region that took part in the survey.

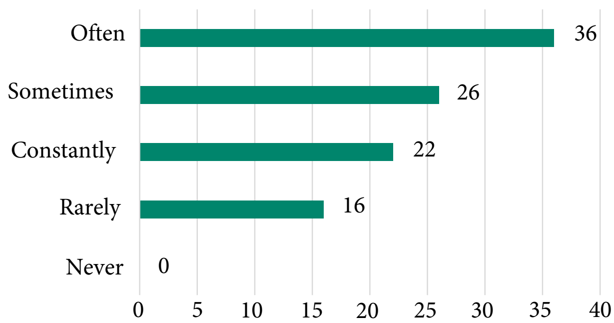

Figure 2. Frequency of use of digital technologies by 50 small businesses in the Kyiv region, %
Source: developed by the authors

The graph in Figure 2 shows that of the 50 small businesses operating in the retail and wholesale trade sector in the Kyiv region, the majority (58%) actively use digital tools. This demonstrates their desire for change and the introduction of new technologies in their activities. This level of digitalisation helps optimise business processes, improve customer service, and manage resources efficiently, which are important factors for ensuring stability and competitiveness in a long-term war. Thereby, about 26% of enterprises use digital solutions only sometimes, which may be due to limited resources, insufficient technical support, or lack of information about the capabilities of digital technologies. Another 16% of respondents reported rarely using such solutions, which indicates that barriers to their wider implementation exist. This calls into question

Table 3. Advantages and potential risks of using digital technologies in small businesses

Digital technology	Description	Advantages for small businesses	Application examples	Potential risks or limitations
Artificial intelligence	A technology that analyses large amounts of data and makes decisions based on algorithms.	Process optimisation, cost reduction, trend forecasting, and automation of routine tasks.	Sales analysis, demand forecasting, and automation of request processing. Artificial intelligence, in particular ChatGPT in version 4.0, performs the functions of a personal assistant. Although it is not able to completely replace real assistants, its capabilities make it easier to perform a variety of tasks. AI requires initial training, but then adapts to the specific needs of the user, analyses situations, and offers solutions that consider what will be acceptable to the customer and what will not. Due to this, it can be configured as much as possible according to individual requirements.	Paid subscription to GPT-4o. The need for staff training, the complexity of developing algorithms.
Cloud technologies	Technologies for storing and processing data on remote servers.	Reducing IT infrastructure costs, accessing data at any time and from any device, lowering the risk of data loss.	Cloud technologies are divided into three main types. Infrastructure as a service (IaaS) leases virtual resources, such as servers and storage (for example, Amazon Web Services, Microsoft Azure). Platform as a service (PaaS) allows developers to create and deploy applications on a ready-made platform (Google App Engine, Heroku). Software as a service (SaaS) provides access to applications through a subscription without the need for installation (Google Workspace, Microsoft 365, Dropbox).	Dependence on the internet connection, risks of failures in the operation of cloud servers, privacy issues.
Blockchain technologies	A decentralised system for storing data and conducting transactions.	Increasing transparency, security of financial transactions, protection against fraud.	Common in the world: Ethereum is mainly used for developing smart contracts and decentralised applications. Quorum is used to minimise the risk of data falsification during transactions. Hyperledger Fabric is used to develop enterprise applications that meet the needs of organisations in various industries. Multichain is a universal blockchain platform for various business areas (finance, education, retail, HR management).	Implementation complexity, limited by a lack of specialists, and high implementation costs.
Mobile apps	Software for smartphones and tablets that provides specific functionality.	Facilitating customer interaction, accessing services and products, and automating tasks from anywhere.	Online stores, mobile payment systems, logistics management.	High competition in the mobile app market, the need for constant updates for compatibility with new operating systems. On average, high-quality support and maintenance ranges from USD 1,500 to 2,500 per month.
Chatbots	Software agents for automatic interaction with clients via text or voice.	Improving communication with customers, 24/7 availability, saving resources on user support.	Automation of responses to customer requests, conducting marketing campaigns.	The ability to process complex requests is limited, and there is a necessity for periodic configuration to adapt to new needs. The cost of developing and implementing 1 chatbot is at least USD 300.
CRM system	A tool for managing customer relationships and analysing data about them.	Sales increase, interaction personalisation, customer behaviour analysis.	Tracking purchase history, managing customer requests, and analysing campaign performance. Common systems: Bitrix24, AmoCRM, Zoho CRM, Salesforce, Pipedrive, InSales.	Paid subscription. Complexity of adaptation to business specifics, need for staff training, risks of data loss in case of technical failures.
ERP system	Comprehensive enterprise resource management software.	Centralised data management, process coordination, cost reduction, and improved management efficiency.	Automation of accounting, warehouse management, production planning. Microsoft Dynamics ERP, SAP ERP, DeloPro, Galaktika ERP, Oracle ERP, BAS ERP, Perfectum, Onebox ERP (+CRM), Endnext, and FS Applications are common in Ukraine.	High implementation cost (about USD 7,500), the need for long-term configuration, difficulty in integrating with existing systems.

Source: developed by the authors

the possibility of ensuring a uniform economic recovery without additional measures to train personnel, finance digital initiatives, and build infrastructure.

Small businesses, according to the survey (Fig. 3), mainly use online stores (88% of enterprises), which helps expand sales channels and attract customers via the Internet. In Ukraine, the most popular platforms for online sales are Prom.ua, OLX, and Rozetka. The Prom.ua platform unites thousands of stores and private sellers, offering automation of business processes through CRM systems. OLX is a convenient platform for buying and selling new and used products without intermediaries, with an emphasis on speed and ease of interaction. Rozetka is a marketplace with a wide range of integrated CRM systems to optimise business and improve customer experience.

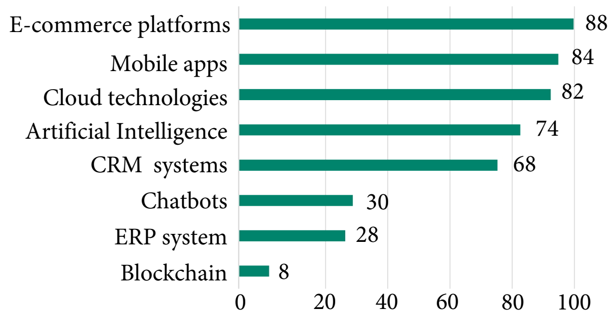

Figure 3. Distribution of digital technologies used by 50 small businesses in the Kyiv region, %
Source: developed by the authors

Most often, businesses use mobile applications of the above-mentioned trading platforms (84% of businesses), which adds convenience to customer interaction. Cloud technologies (Google Drive) are used by 82% of enterprises, storing and processing data with flexible access and without physical infrastructure costs. Artificial intelligence is used by 74% of enterprises, mainly to automate processes and analyse data, in particular, to develop personalised product recommendations based on customer purchase analysis, automate order processing, and predict demand for inventory management. Artificial intelligence helps create product descriptions with their preferences.

CRM systems are used by 68% of enterprises, which indicates an interest in automating customer relationship management. Popular CRM systems are Bitrix24, which offers a wide range of tools for managing tasks and interacting with customers, and AmoCRM, which is focused on the convenience of working with the customer base. Zoho CRM and Salesforce are popular among companies due to their versatility. Pipedrive focuses on the automation of sales, and "Khoroshop", due to affordable subscription prices is available for small businesses. Chatbots are used in 30% of businesses, reflecting the use of this technology to improve customer service. ERP systems are used by 28% of enterprises, which indicates a growing need for integrated resource management. Blockchain is identified in only 8% of enterprises, which indicates its limited use among small enterprises in the Kyiv region. In the conditions of war, small businesses in the Kyiv region act as an important economic front that ensures not only economic stability but also support for the state budget through taxes.

Analysing the factors that influence the adoption of digital technologies in small businesses allows to understand what motivations guide entrepreneurs in choosing digital technologies to improve their business processes. In particular, these may include factors such as reducing costs, improving efficiency, facilitating business processes, innovation, improving customer service, and expanding the market. In the context of war and a difficult economic situation, enterprises are looking for opportunities to maintain stability, optimise resources and quickly adapt to changing conditions. Figure 4 shows the factors that contributed to the introduction of digital technologies among 50 small businesses in the Kyiv region. The main factors driving this step are lower costs, supplemented efficiency, improved customer service, and increased competitiveness.

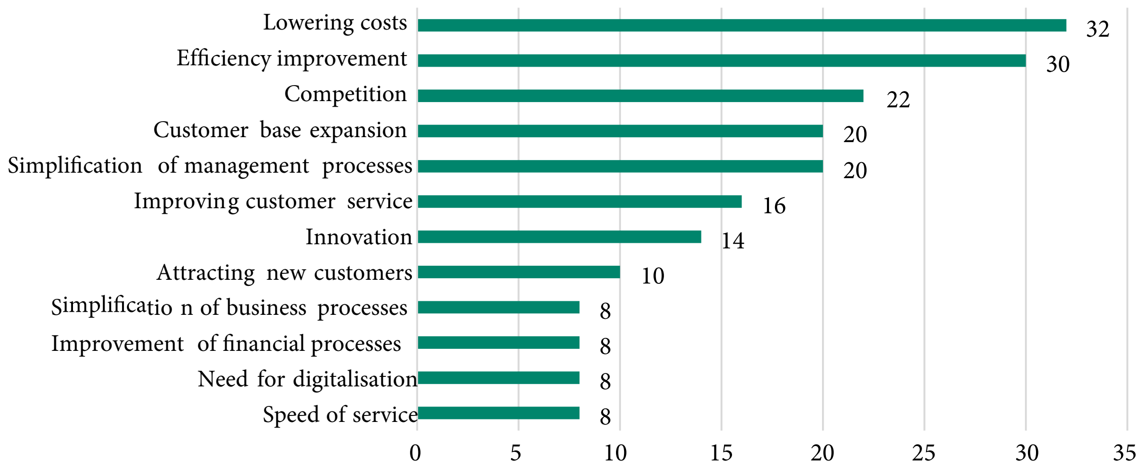

Figure 4. Factors that contributed to the introduction of digital technologies at 50 small businesses in the Kyiv region, %
Source: developed by the authors

Cost reduction – this factor is present in almost half of enterprises, which indicates the desire of businesses to optimise costs, especially in the context of economic instability caused by the war. For small businesses, it is important to reduce the cost of production and administrative processes, which allows maintaining profitability. Improving efficiency is the second most important factor that indicates the desire of businesses to improve their internal processes and reduce the time spent on completing tasks. Competition is important for 22% of enterprises and reflects the need to maintain the occupied market niche.

Every fifth enterprise notes the importance of facilitating its business processes, especially managerial ones, which allows levelling the human factor and reducing the likelihood of mistakes. Digital technologies provide for automating routine operations, which helps to reduce the time and resources spent on their implementation. The expansion of the market and customer base indicates the strategic intentions of enterprises to expand their presence in the market and attract new customers. In a wartime environment where physical sales channels may be limited, digital tools help find new growth opportunities (Liutak & Baula, 2024). However, only 14% of businesses seek to use digital technologies to offer customers new solutions. This allows them to maintain competitiveness and simultaneously create new business models.

The introduction of digital technologies in small businesses faces many challenges that greatly hinder the process. The main one is the high cost of their integration, which is burdensome for many enterprises in conditions of economic instability (Fig. 5). These costs include both direct financial costs and infrastructure upgrades, which is an additional burden for the business. Another substantial problem is the lack of qualification of personnel, which complicates mastering new tools and using them effectively in the course of activities. Although 3/4 of enterprises train their staff to use digital technologies (through various courses, programmes, and training), the rest consider this unnecessary (Fig. 6).

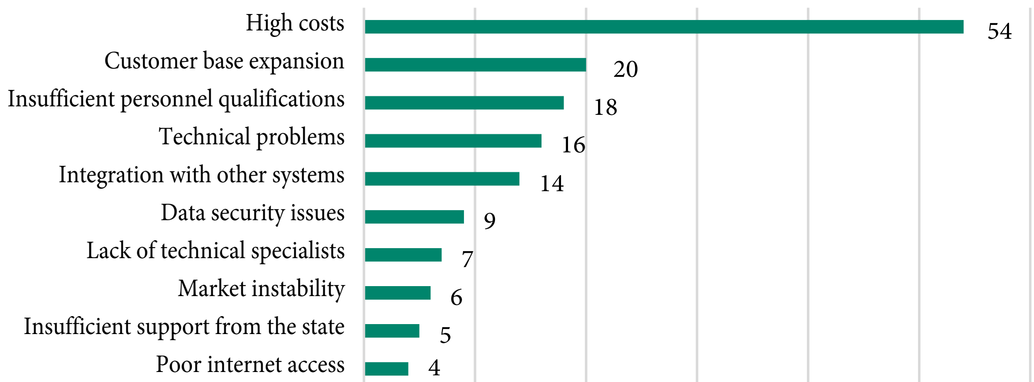

Figure 5. Problems that hinder the further development of digital technologies for 50 small businesses in the Kyiv region, %
Source: developed by the authors

Figure 6. Distribution of enterprises regarding employee training in digital technologies, %
Source: developed by the authors

An obstacle to digitalisation is the lack of state support, which manifests itself in the form of insufficient investment in the relevant infrastructure. For many enterprises, there is a problem of adapting new technologies to existing business systems, which is complicated by integration problems and the lack of necessary technical resources. Technical difficulties are also an important barrier to implementation because small businesses often do not have the opportunity to attract a sufficient number of qualified IT specialists, which leads to difficulties in solving technical problems. An important aspect is market instability, which affects the ability of enterprises to make long-term investments in digital technologies. These problems together hinder digitalisation, which requires a systematic approach to solving them at the level of enterprises and the state.

Figure 7 shows an assessment of the impact of the use of digital technologies and artificial intelligence on enterprise efficiency. The results of a survey of 50 small enterprises in the Kyiv region indicate a positive trend in the introduction of digital technologies and artificial intelligence in their activities. Only 16% of enterprises rated their impact as minimal, which may be due to insufficient use of technologies and inexperience of staff.

28% of enterprises consider the impact to be medium, which indicates the gradual integration of digital solutions. The largest share – 56% of enterprises – noted the maximum impact of technology, which indicates the active use of innovations to optimise business processes, automate, improve customer service, and make managerial decisions. During the survey, almost half of business leaders noted the impact of digital technologies on the recovery of economic activity. 22% of respondents considered the impact to be maximum, and 26% rated it as medium (Fig. 8). A small number of low-impact opinions (4%) indicate the overall effectiveness of digital solutions in this context. The predominance of high ratings demonstrates the positive contribution of digital technologies to supporting economic activity.

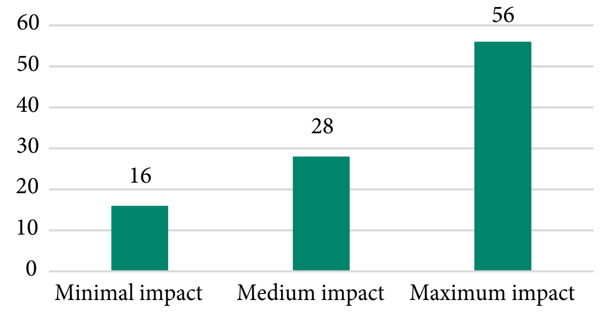

Figure 7. Answers to the question "How do you assess the impact of using digital technologies and artificial intelligence on the efficiency of your enterprise", %
Source: developed by the authors

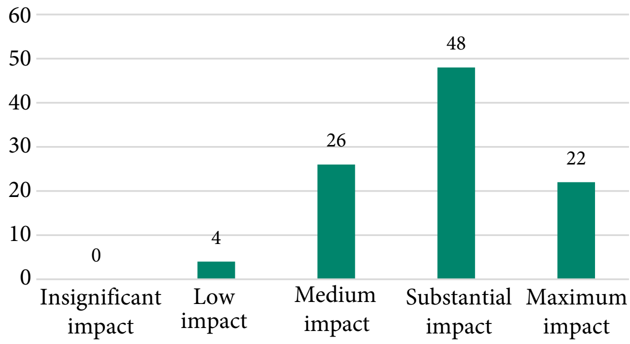

Figure 8. Impact of the use of digital technologies and artificial intelligence on the recovery of economic activity of 50 small businesses in the Kyiv region, %
Source: developed by the authors

This conclusion is supported by a moderate correlation between the use of digital technologies and indicators of economic recovery. The use of the correlation method allows more accurately assessing the degree of influence of digital technologies on post-war reconstruction, identifying the strengths and weaknesses of their implementation, and pinpointing potential optimisation directions (Tables 4, 5).

Table 4. Results of the analysis of the relationship between digital technology usage and enterprise economic recovery

Enterprise	Use of digital technologies (X)	Recovery rates (Y)	Product (XY)	Digital technology square (X^2)	Recovery indicators square (Y^2)
1	4	5	20	16	25
2	3	4	12	9	16
3	5	5	25	25	25
...	...	...	...	...	...
50	4	5	20	16	25
Total	177	200	725	671	836

Source: developed by the authors

Table 5. Results of ANOVA correlation-regression and variance analysis

Regression statistics					
Multiple R			0.425116923		
R-Squared			0.180724398		
Adjusted R-Squared			0.163656157		
Standard error			0.870730324		
Number of observations			50		
ANOVA analysis of variance					
-	**Df**	**SS**	**MS**	**F.**	**Significance F**
Regression	1	8.027778	8.027778	10.58834	0.002088
Residual	48	36.39222	0.758171	-	-
Total	49	44.42	-	-	-
	Coefficients	**Standard error**	**t-statistic**	**p-value**	-
Y-intercept	1.651111111	0.593404	2.78244	0.007691	-
Coefficient for X1	0.472222222	0.145122	3.253973	0.002088	-

Source: developed by the authors

The results of correlation and regression analysis showed a direct moderate relationship between the level of digital technology use and the recovery of economic activity of enterprises, which indicates the multi-factor nature of this process. The multiple correlation coefficient ($R = 0.425$) indicates the existence of a positive relationship, but its value is not high enough to indicate a strong relationship. This means that with an increase in the level of digitalisation, a partial improvement in the economic performance of enterprises can be anticipated, but this effect is not dominant. The value of the R-square (0.181) indicates that only 18% of changes in the recovery of economic activity can be explained by the impact of the level of use of digital technologies. The remaining 82% depends on other factors, such as the level of managerial competence, the external economic environment, the availability of resources, government support, etc.

The standard error value (0.87) indicates the degree of discrepancy between actual and predicted values, suggesting a certain level of instability in forecasting the relationship. However, the low significance F-value (0.002) and the p-value for the regression coefficient (0.002) confirm the statistical significance of the model. This implies that while the level of digital technology adoption is an important factor, it is not the sole determinant. The coefficient for variable X1 (0.472) indicates that an increase of one unit in the level of digital technology adoption corresponds to an approximate 0.472 increase in the average level of economic recovery. Meanwhile, the Y-intercept (1.651) reflects the baseline level of post-war recovery efficiency for enterprises with minimal digital technology usage. Therefore, the analysis underscores the importance of digital technologies in the economic recovery of enterprises. Nevertheless, their impact should be considered alongside other internal and external factors, as confirmed by the results of the correlation-regression analysis.

DISCUSSION

This study demonstrates that most small enterprises in the retail and wholesale sectors are gradually integrating digital tools, reflecting their efforts to adapt to challenging conditions. This transition enables them to enhance and accelerate economic processes, optimise customer service, and manage resources more effectively. However, a substantial proportion of businesses only partially implement digital solutions, primarily due to resource constraints, insufficient information, or inadequate technical support (Makedon *et al*., 2024). This highlights the need for further efforts to develop digital culture and infrastructure. The findings indicate that digital transformation in small businesses progressed unevenly, with many enterprises adopting digital technologies only to a limited extent. Similar conclusions were drawn by other researchers, such as I. Khurana *et al*. (2022), who emphasised the importance of developing digital competencies during periods of crisis, as this enhances business adaptability to change. Using a qualitative approach based on case studies of eight Indian entrepreneurs who were forced to radically alter their business models and operations during the COVID-19 pandemic, the authors developed a multi-level resilience model encompassing the micro-level (entrepreneur level), meso-level (organisational level), and macro-level (entrepreneurial ecosystem level). However, the results of this study contradict the findings of B. Lv *et al*. (2024), who argued that digital transformation was widely adopted among small enterprises in the post-pandemic period. This discrepancy may be attributed to differences in regional research contexts, technology accessibility, and levels of government support.

Among small retail and wholesale businesses, the most widely used digital tools are e-commerce platforms, mobile applications, and cloud technologies. Their adoption facilitates the expansion of sales channels, improves data accessibility, and automates business processes. There is also a growing interest in artificial intelligence and CRM systems, which enhance customer relationship management and data analysis. The use of digital tools, such as mobile applications, increased business process efficiency. These findings align with the study by Z. Adiguzel (2024), who also identified digital technologies as a key driver of innovative entrepreneurial ideas.

The study by J.G. Carrasco Ramírez (2023) highlighted those mobile applications can contribute to the development of small businesses by providing new opportunities for consumer engagement, process automation, and market expansion. Through the integration of artificial intelligence and mobile technologies into strategic business operations, the author proposed a comprehensive approach to innovation, adaptation, and growth in an era characterised by rapid technological advancements and evolving consumer expectations. The findings of the present study also confirmed these trends, as enterprises that actively utilised mobile and digital technologies exhibited higher levels of adaptability and innovation, even in the context of war and martial law.

Less widespread but promising technologies, such as blockchain, indicate potential for future development. These findings align with the study by D. Darwish (2023), who noted that blockchain remained in the early stages of integration despite its considerable potential for enhancing business resilience. In addition, L.S. Hanwacker (2024) emphasised that the implementation of blockchain technologies required substantial investment and technical expertise, which often hindered their widespread adoption. The results of the present study similarly demonstrated that small enterprises tended to prioritise more accessible digital tools, which may explain the low level of blockchain adoption.

Furthermore, it was discovered that the use of artificial intelligence remained limited, despite growing interest in this technology. This corresponds with the findings of P. Agarwal *et al*. (2022) and P. Haritha (2024), who highlighted that the integration of artificial intelligence in business was hindered by high costs and insufficient technical expertise among staff. However, Z. Adiguzel (2024) provided successful examples of AI applications in crisis management, underscoring the long-term potential of such technologies. The present study demonstrated that the rate of adoption of these technologies among small businesses was lower than among medium-sized and large enterprises, partially contradicting the findings of R. AbuShanab (2024), who asserted that, in the new economic conditions, digital technologies were rapidly implemented even by small enterprises.

The findings also reinforced the importance of digital infrastructure for businesses (Synytsina *et al*., 2022). This corresponds with the conclusions of K. Kraus & N. Kraus (2024), who emphasised the potential of Industry 5.0 technologies to enhance business productivity. The analysis further revealed that the strategic flexibility of small enterprises remained low, consistent with the findings of Z. Ahmad *et al*. (2024), who stressed the importance of artificial intelligence as a key factor in strategic adaptability. The importance of transforming production processes through digital tools was also confirmed by M. Koumas *et al*. (2021).

Digitisation in small businesses influences their ability to adapt to crises or challenges. Enterprises that actively utilise digital technologies have more opportunities compared to those that do not integrate such technologies into their economic activities. However, some barriers slow down this process, including the high costs associated with integrating new solutions, and a lack of skilled personnel and technical resources (Sargiotis, 2024). The war and complex economic situation highlighted the importance of digital technologies for the recovery of economic activity. These technologies help maintain operations even when physical distribution channels are limited, reduce dependence on conventional resources, and open up new growth opportunities. This makes digitisation a strategic priority for small businesses in an environment of constant change. These conclusions align with the findings of the aforementioned authors.

Despite the positive impact of digital technologies, their usage is not the sole determinant of economic stability, as many factors depend on external conditions, managerial competence, and the availability of resources. Successful implementation of digital solutions is only possible in conjunction with other measures, such as staff training, financial support, and infrastructure modernisation, which create opportunities for further growth and development of small businesses while strengthening their role in the overall economy of the country.

CONCLUSIONS

Digitisation is becoming a vital factor for small businesses to adapt to complex challenges, such as military conflicts, high levels of competition, and physical restrictions on customer access. The active use of digital tools such as artificial intelligence, mobile applications, blockchain, cloud services, and others allows businesses to optimise processes, improve customer service, and increase management efficiency. It was established that innovative solutions, particularly ERP systems and blockchain, are less actively implemented, indicating their potential but also highlighting the need for resources and technical support. The barriers to digitisation, such as limited resources, insufficient technical training of personnel, and a lack of knowledge about these technologies, hinder the uniform development of small businesses. However, even in the challenging conditions of war, digital technologies demonstrate their importance in the future recovery of economic activities, as they help small businesses remain competitive, reduce reliance on conventional methods of operation, and open new opportunities for market expansion. The results of regression analysis revealed a direct interdependence between the implementation of digital technologies and the recovery of economic activity in enterprises. Nevertheless, this connection is moderate, indicating the complex and multifactorial nature of the process. A limitation of this study is that it primarily focuses on small businesses in the Kyiv region, which may restrict the generalisation of the findings to other regions of Ukraine. The study also considers only specific types of digitisations, without encompassing all possible technological innovations that could impact business operations. In addition, the analysis was conducted under martial law conditions, which affected economic activity and business behaviour, potentially distorting the assessment of the impact of digital technologies under ordinary circumstances. Finally, the study is based on available data and surveys, which may have limited the depth of the analysis due to the subjectivity of respondents' answers and the absence of data on certain indicators. Future research could focus on exploring the impact of digitisation on other aspects of economic activity, particularly the enhancement of innovation potential and business resilience. It would also be beneficial to examine regional differences in the digitisation of business and the effectiveness of government initiatives in supporting this process.

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REFERENCES

[1] AbuShanab, R. (2024). Advancing economic recovery with artificial intelligence, quantum computing technologies, and strategic management in small businesses. *Journal of Artificial Intelligence General Science*, 5(1), 327-338. doi: 10.60087/jaigs.v5i1.201.

[2] Adiguzel, Z. (2024). Effects of digital applications and artificial intelligence technologies in businesses. In F. Özsungur (Ed.), *Generating entrepreneurial ideas with AI* (pp. 41-69). Hershey: IGI Global. doi: 10.4018/979-8-3693-3498-0.ch003.
[3] Agarwal, P., Swami, S., & Malhotra, S.K. (2022). Artificial intelligence adoption in the post COVID-19 new-normal and role of smart technologies in transforming business: A review. *Journal of Science and Technology Policy Management*, 15(3), 506-529. doi: 10.1108/JSTPM-08-2021-0122.
[4] Ahmad, Z., Alwadi, B.M., Kumar, H., Ng, B.-K., & Nguyen, D.N. (2024). Digital transformation of family-owned small businesses: A nexus of Internet entrepreneurial self-efficacy, artificial intelligence usage, and strategic agility. *Kybernetes*. doi: 10.1108/K-10-2023-2205.
[5] Carrasco Ramírez, J.G. (2023). How mobile applications can improve small business development. *Eigenpub Review of Science and Technology*, 7(1), 291-305.
[6] Chen, J., Lim, C.P., Tan, K.H., Govindan, K., & Kumar, A. (2021). Artificial intelligence-based human-centric decision support framework: An application to predictive maintenance in asset management under pandemic environments. *Annals of Operations Research*. doi: 10.1007/s10479-021-04373-w.
[7] Chorna, O. (2022). Regulatory support and institutions for the transformation of enterprises to the digital economy. *Management of Economy: Theory and Practice, Chumachenko's Annals,* 2022, 51-82. doi: 10.37405/2221-1187.2022.51-82.
[8] Darwish, D. (2023). Blockchain and artificial intelligence for business transformation toward sustainability. In S. Namasudra & K. Akkaya (Eds.), *Blockchain and its applications in Industry 4.0* (pp. 211-255). doi: 10.1007/978-981-19-8730-4_8.
[9] De Winter, J., & Dodou, D. (2010). Five-point Likert items: T-test versus Mann-Whitney-Wilcoxon. *Practical Assessment, Research, and Evaluation*, 15(1), article number 11. doi: 10.7275/bj1p-ts64.
[10] European Commission. (2021). *Ethics and data protection*. Retrieved from https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ethics-and-data-protection_he_en.pdf.
[11] Eurostat. (2025). *Use of artificial intelligence in enterprises*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Use_of_artificial_intelligence_in_enterprises&gt.
[12] Hanwacker, L.S. (2024). The role of artificial intelligence in disaster recovery. *Journal of Business Continuity & Emergency Planning*, 18(2), 167-179. doi: 10.69554/CYWN4471.
[13] Haritha, P. (2024). Digital transformation of business and influence of artificial intelligence. *ANVESHAK – International Journal of Management*, 13(1), 51-70. doi: 10.15410/aijm/2024/v13i1/173205.
[14] International Business Machines Corporation. (2022). *IBM global AI adoption index 2022: New research commissioned by IBM in partnership with morning consult*. Retrieved from https://www.ibm.com/downloads/documents/us-en/107a02e94a48f5c1.
[15] Kholiavko, N., Olyfirenko, I., & Kononenko, S. (2024). The impact of innovative digital technologies on the post-war recovery of Ukrainian universities. *Business Inform*, 8, 141-150. doi: 10.32983/2222-4459-2024-8-141-150.
[16] Khurana, I., Dutta, D.K., & Ghura, A.S. (2022). SMEs and digital transformation during a crisis: The emergence of resilience as a second-order dynamic capability in an entrepreneurial ecosystem. *Journal of Business Research*, 150, 623-641. doi: 10.1016/j.jbusres.2022.06.048.
[17] Koumas, M., Dossou, P.-E., & Didier, J.-Y. (2021). Digital transformation of small and medium-sized enterprises production manufacturing. *Journal of Software Engineering and Applications*, 14(12), 607-630. doi: 10.4236/jsea.2021.1412036.
[18] Kraus, K., & Kraus, N. (2024). Search of opportunities for digitalization of infrastructure and establishment of industry 5.0 based on the application of artificial intelligence: Regional aspect of digital transformation. *Economics. Finances. Law*, 6, 63-68. doi: 10.37634/efp.2024.6.13.
[19] Li, C., & Wang, Y. (2024). Digital transformation and enterprise resilience: Enabling or burdening? *PLoS ONE,* 19(7), article number e0305615. doi: 10.1371/journal.pone.0305615.
[20] Liutak, O., & Baula, O. (2024). Optimising the focus of digital technologies in the context of implementing a sustainable development strategy for the international business environment. *Economic Forum*, 14(3), 8-20. doi: 10.62763/cb/3.2024.08.
[21] Lv, B., Deng, Y., Meng, W., Wang, Z., & Tang, T. (2024). Research on digital intelligence business model based on artificial intelligence in the post-epidemic era. *Management Decision*, 62(9), 2937-2957. doi: 10.1108/MD-11-2022-1548.
[22] Makedon, V., Kostyshyna, T., Tuzhylkina, O., Stepanova, L., & Filippov, V. (2019). Ensuring the efficiency of integration processes in the international corporate sector on the basis of strategic management. *Academy of Strategic Management Journal*, 18(1).

[23] Makedon, V., Myachin, V., Plakhotnik, O., Fisunenko, N., & Mykhailenko, O. (2024). Construction of a model for evaluating the efficiency of technology transfer process based on a fuzzy logic approach. *Eastern-European Journal of Enterprise Technologies*, 2(13(128)), 47-57. doi: 10.15587/1729-4061.2024.300796.

[24] Martín-Rojas, R., Garrido-Moreno, A., & García-Morales, V.J. (2023). Social media use, corporate entrepreneurship and organizational resilience: A recipe for SMEs success in a post-Covid scenario. *Technological Forecasting and Social Change*, 190, article number 122421. doi: 10.1016/j.techfore.2023.122421.

[25] Mykhalchenko, H., Zhuravlova, I., Zhalinska, I., Saienko, V., & Ovander, N. (2023). Digital tools for anti-crisis management of enterprises: The Ukrainian case. *Amazonia Investiga*, 12(64), 291-299. doi: 10.34069/AI/2023.64.04.30.

[26] Sargiotis, D. (2024). Integrating digital transformation and AI in civil engineering: A multidisciplinary approach to disaster management and sustainable urban development. *SSRN Electronic Journal*. doi: 10.2139/ssrn.4789752.

[27] Sherif, A. (2024) *Spending on digital transformation technologies and services worldwide from 2017 to 2027*. Retrieved from https://www.statista.com/statistics/870924/worldwide-digital-transformation-market-size/.

[28] Ståhle, L., & Wold, S. (1989). Analysis of variance (ANOVA). *Chemometrics and Intelligent Laboratory Systems, 6*(4), 259-272. doi: 10.1016/0169-7439(89)80095-4.

[29] Stepanenko, R. (2024). Priorities and risks of digital transformation in forming the needs of management of modern ecosystems. *Actual Problems of Innovative Economy and Law*, 5, 16-20. doi: 10.36887/2524-0455-2024-5-3.

[30] Synytsina, Y., Abramov, S., & Manole, A. (2022). Improving the information system of the enterprise through the use of neural networks. *Philosophy, Economics and Law Review*, 2(1), 127-138.

[31] Tyshchenko, V., Bielousov, Ya., Yemets, V., Borodenko, T., & Beder, D. (2024). The impact of digital transformation on the development of post-war regions of Ukraine. *Amazonia Investiga*, 13(81), 86-97. doi: 10.34069/AI/2024.81.09.6.

[32] Voronkova, V., Cherep, O., & Bexhter, L. (2024). Conceptual foundations for the formation of personnel strategy at industrial enterprises in the context of digitalisation. *Baltic Journal of Economic Studies*, 10(2), 60-67. doi: 10.30525/2256-0742/2024-10-2-60-67.

[33] White, G., & Liptak, S. (2024). Small business continuity and disaster recovery plans using AI and ChatGPT. *Issues in Information Systems*, 25(4), 118-126. doi: 10.48009/4_iis_2024_109.

[34] Yevtushenko, N., & Stetsenko, D. (2024). Digital transformation of business in the context of war in Ukraine: Challenges and opportunities. *Economic Scope*, 191, 211-216. doi: 10.32782/2224-6282/191-34.

Вячеслав Македон

Доктор економічних наук, доцент
Дніпровський національний університет імені Олеся Гончара
49010, просп. Науки, 72, м. Дніпро, Україна
https://orcid.org/0000-0001-8131-0235

Дмитро Коптілий

Кандидат економічних наук, заступник директора
Товариство з обмеженою відповідальністю «Флайт Контроль»
49170, просп. Науки, 115, м. Дніпро, Україна
https://orcid.org/0009-0004-7390-8746

Цифрова трансформація та штучний інтелект як фактори відновлення економічної діяльності підприємств після військових конфліктів

Анотація. Цифрова трансформація та впровадження штучного інтелекту відкривають нові перспективи для відновлення й поступового розвитку економічної діяльності малих підприємств, забезпечуючи їхню здатність реагувати на післявоєнні виклики і більш ефективно використовувати інноваційні технологічні рішення. Дослідження було спрямоване на визначення впливу використання цифрових інструментів та штучного інтелекту на відновлення економічної діяльності малих підприємств в постконфліктний період. Для збору даних було розроблено структуровану онлайн-анкету з шести блоків питань, які охоплювали різні аспекти цифрової трансформації малих підприємств. Питання стосувалися рівня впровадження цифрових технологій, типів використовуваних інструментів, основних бар'єрів для цифровізації, впливу цифрової трансформації на економічне відновлення економічної діяльності підприємств тощо. Кореляційно-регресійний аналіз відповідей дозволив оцінити статистичну взаємозалежність між впровадженням цифрових технологій та відновленням економічної діяльності підприємств. Більшість з 50 торгових підприємств малого бізнесу у Київській області, що взяли участь в опитуванні, активно використовують цифрові інструменти, зокрема онлайн-магазини, мобільні додатки, штучний інтелект, хмарні технології, що свідчить про високий рівень адаптації до сучасних бізнес-умов. Виявлено, що інноваційні рішення, зокрема ERP-системи та блокчейн, впроваджують менш активно, що вказує на потребу у значних ресурсах і технічній підтримці. Кореляційний аналіз підтвердив прямий помірний зв'язок між рівнем використання цифрових технологій і відновленням економічної діяльності підприємств, що підтверджує важливість інноваційних рішень у забезпеченні стабільності та розвитку бізнесу в умовах економічних викликів. Результати дослідження можуть бути корисними для органів влади та державних установ, що розробляють політику підтримки цифровізації малого бізнесу, а також для підприємств у процесі прийняття рішень щодо інвестицій у нові технології

Ключові слова: хмарні технології; блокчейн-технології; мобільні додатки; чат-боти; інформаційні технології

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Oleh Marchuk*
Master
Ivan Franko National University of Lviv
79000, 1 Universitetska Str., Lviv, Ukraine
https://orcid.org/0009-0001-8006-4789

Taras Kushnir
PhD in Economics, Associate Professor
Ivan Franko National University of Lviv
79000, 1 Universitetska Str., Lviv, Ukraine
https://orcid.org/0000-0003-1643-2273

Refining search engine marketing strategy: Balancing long-term search engine optimisation investment with immediate pay-per-click results

Abstract. This study examined the relevance of integrating methods for attracting organic and paid traffic to increase business visibility and profitability. The purpose of this study was to determine the best balance between long-term investments in search engine optimisation (SEO) and the immediate results provided by pay-per-click (PPC) advertising. The study employed methods of comparative analysis, theoretical synthesis, and consideration of practical cases of implementing search marketing in e-commerce. The findings showed that SEO created a solid foundation for organic traffic, reducing dependence on paid advertising and providing a high return on investment (ROI) in the long term. At the same time, PPC advertising provided a rapid market response, effective keyword testing, and instant visibility of products or services. A combined approach to search engine marketing integrating SEO and PPC proved to be the most effective for higher conversion rates, improved user interaction, and increased customer satisfaction. The practical value of this study lies in formulating strategic principles for setting up search marketing to minimise costs, increase competitiveness, and achieve sustainable growth. Effective search marketing requires an individual approach that considers market characteristics, business specifics, and financial resources. These findings provided practical information for developing marketing strategies for use in various industries

Keywords: online visibility; search ranking strategy; paid search advertising; advertising efficiency; website promotion; organic traffic

INTRODUCTION

Internet marketing is one of the key tools used for the successful functioning of a business in a digital environment. The criticality of its application is determined by the benefits that can be obtained from its use: the ability to adapt to the needs and changes in audience behaviour, ensuring proper targeting and the ability to assess the effectiveness and profitability of invested resources. In modern conditions, where more businesses are increasing their presence on the Internet, effective promotion on the network is becoming a necessary condition for existence.

K. Symonenko (2024) noted that in total, 2.71 billion people around the world in 2024 made online purchases

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*Corresponding author

on specialised e-commerce platforms or on social networks. This meant that ~33% of the world's population bought online, which was ~2.7% more than in 2023. In 2025, the number of online buyers was forecast to increase to 2.77 billion due to the further development of e-commerce, greater Internet penetration, and the convenience of shopping. This significant increase not only highlighted the rapid growth and expanding reach of the global e-commerce market but also reflected the increasing trust consumers had in online transactions. The steady rise of 2.7% from 2023 underlined a consistent growth trend, while the forecast for 2025 suggested that businesses should continuously adapt their digital strategies to harness the evolving consumer behaviour and capitalise on the expanding opportunities in online retail. Since the 2000s, brands and businesses have changed due to digitalisation. N. Hien & T. Nhu (2022) noted that this strategy became increasingly popular and was gradually emerging as a global trend. This shift reflected a profound transformation in the market, where conventional marketing methods were being displaced by innovative digital approaches that enabled companies to better connect with consumers and respond to evolving preferences in real time.

Since individual business entities operate in different conditions (industry, budget, target audience, competition), there are no universal solutions. For example, for long-term purposes, search engine optimisation (SEO) offers sustainable benefits over pay-per-click (PPC), while if there is a need to quickly attract targeted traffic, contextual advertising emerges as one of the best tools. O. Marchuk & T. Kushnir (2024) suggested that this distinction underscored a fundamental strategic decision: businesses must weigh the enduring value of organic growth through SEO against the immediate impact and flexibility of PPC. This observation highlighted the significance of aligning digital marketing strategies with concrete business objectives, ensuring that companies can effectively balance short-term visibility with long-term brand development.

N. Cuijten *et al.* (2024) highlighted that micro enterprises exhibited noTable gaps, particularly in strategy planning, personalisation, content creation, and brand building, suggesting areas for improvement. Medium enterprises showed alignment but still had room for growth in strategy and content creation, while small enterprises demonstrated the closest alignment between capabilities and needs, with fewer identified gaps. These findings suggested that while digitalisation and marketing strategies were evolving across businesses of varied sizes, smaller enterprises could have a strategic advantage in agility and adaptability. However, micro and medium enterprises should prioritise strategic development and content optimisation to stay competitive.

N. Volkova *et al.* (2021) noted that the digital transformation of the economy is a constant and consistent process that concerns not only the development of IT sectors, but also the digitalisation of other related sectors of the economy, which stimulates the introduction of innovative technologies and provides a powerful impetus for the further development of all socio-economic spheres at the international level. This pervasive digitalisation acts as a critical driver for cross-sectoral innovation, blurring conventional economic boundaries and enhancing operational efficiencies. This ongoing process not only fosters a more competitive global market but also lays the groundwork for sustainable growth by continuously integrating advanced digital solutions into various industries. A. Osan (2023) noted that search engine marketing (SEM) is a digital marketing strategy aimed at gaining better visibility through paid advertising as well as by promoting organic search results on a website's search engine results pages (SERPs). This approach allows businesses to combine the immediate impact of paid campaigns with long-term growth strategies, ensuring not only quick audience acquisition but also enhanced brand recognition and consumer trust over time.

SEM is a key tool in modern Internet marketing, as it allows a business to quickly gain visibility in search engines and attract a target audience. By combining SEO and PPC, SEM delivers both long-term results through organic traffic and immediate impact through paid advertising. The return on investment in search marketing can be impressive, especially with finely tuned strategies for specific audiences. Companies earn an average of USD 8 for every USD 1 spent on Google Ads, highlighting the potential of search marketing when used correctly and creatively, according to Google itself (Google Economic Impact, n.d.).

Despite the extensive research of SEM strategies, previous studies in this field have not sufficiently explored the optimised balance between long-term SEO investments and the immediate outcomes of PPC. There is a lack of comprehensive analysis on how businesses can strategically integrate these approaches to maximise their marketing effectiveness while ensuring efficient resource allocation. Therefore, the purpose of this study was to examine the interplay between SEO and PPC within an SEM strategy, focusing on their combined influence on marketing performance and sustainable growth.

MATERIALS AND METHODS

The study employed a comprehensive approach, which integrated both quantitative and qualitative analysis techniques. The material basis for this study included essential reports that provided the core data for statistical analysis. Specifically, the study relied on data from FirstPageSage (2025) and P. Stainton (2024) for calculating performance metrics such as ROI and cost per click, as well as on the reports by R. Arora & P. Tyagi (2024), which supplied critical information for dispersion analysis of SEO and PPC performance across industries, and provided a robust statistical analysis framework that was instrumental in the application of ANOVA.

Apart from the statistical and comparative analyses, a graphical model illustrating the effectiveness of SEO and PPC was developed based on the findings reported by M. Dehlin & Q. Björnfot (2023). This model demonstrated how SEO performance increases over time due to its cumulative nature, while PPC generates immediate but relatively short-lived results that end once the campaign concludes. Consequently, SEO provides a foundation for long-term organic growth, whereas PPC offers quick visibility and conversions but requires ongoing investments to maintain its impact.

For the quantitative analysis, descriptive statistics – including means, standard deviations, and variances – were computed to assess the central tendency and dispersion of SEO and PPC performance indicators. ANOVA (analysis of variance) was then employed to test whether differences in key metrics, e.g., cost per click, between the two strategies were statistically significant. A significance threshold of $p = 0.05$ was adopted, with the analysis revealing that most indicators showed no statistically significant differences, except the one that had to be investigated further.

Furthermore, the return on investment (ROI) for both SEO and PPC was calculated and measured using the data from I. Burban (2025), C. Martin (n.d.), and I. Ugolkov *et al.* (2020). Cost classifications by business size were established based on the essential information provided by A. Shum (2025) and M. Dejnak (2024), with monthly budgets categorised for small, medium, and large enterprises. These analyses formed the basis for comparing the cost efficiency and overall performance of SEO and PPC in different business contexts. The inclusion of these indispensable data sources ensured that the study's statistical foundations were both rigorous and comprehensive.

RESULTS

SEM marketing involves a broad range of activities, including performance analysis, search engine optimisation, and online advertising, aimed at directly connecting with consumers. It enables websites to present products or content to their target audience via search engines and encompasses two main tools: SEO and pay-per-click advertising. Search engine optimisation is a strategy focused on crafting content to ensure that search engines like Google rank a business page prominently on their search engine results pages. Generally, if a webpage's rank is higher, it will be visited by many users. The primary purpose of SEO is to improve the quality and quantity of website traffic and ensure that the webpages appeal to search engines (Saeed *et al.*, 2024). SEO tool improves the rank and visibility in the search engine as it helps to improve the user interaction with the website, this requires that companies can opt efforts to opt with SEO in their web pages (Huacre *et al.*, 2021).

Search engine optimisation is most often divided into two types. On-page SEO handles the content and infrastructure of the website. Off-page SEO, in contrast, pertains to the manner in which external online sources link to the target website (Shahzad *et al.*, 2017). Each subtype also has many dedicated tools. For On-page, this includes content creation, performance optimisation, HTML layout, section structure adjustment, selection of relevant keywords, and site design adaptation. For Off-page, this includes building a link profile, maintaining social networks to transfer traffic to the target website, generating mentions and links on forms and in reviews, and crowd-sourcing.

On-page optimisation involves adjusting a website's content to enhance its performance in search engines. Key elements addressed include the URL, meta title, meta description, title tags, text formatting, alternative text, content, robots.txt, and sitemap.xml. Achieving a first-page position in search engine results is crucial for websites, as it substantially influences their visibility. The process of search engine optimisation involves employing technical and content optimisation strategies to enhance a website's visibility. Central to this effort is the creation of high-quality content that aligns with the search intent of internet users (Çırakoğlu & Koşaner, 2024).

Off-page SEO focuses on boosting a website's domain authority by acquiring backlinks from other repu-Table websites. Notably, search engine optimisation tools contain combined Internet marketing tools, most often their use is effective in concert. SEO is often contrasted with PPC, but there is a fundamental difference. SEO has a long-term and cumulative effect, while PPC works more effectively in the short term, with the effect not accumulating over time (Fig. 1).

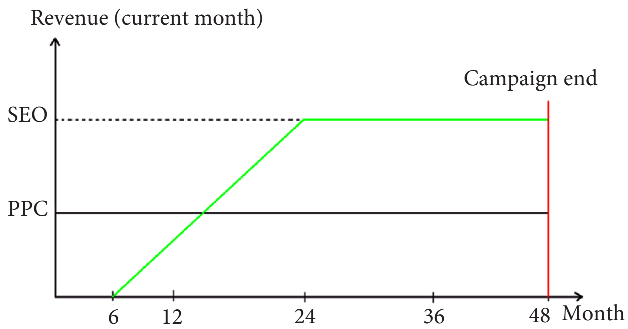

Figure 1. SEO and PPC effectiveness comparison model
Source: prepared based on research data by M. Dehlin & Q. Björnfot (2023)

In the highly competitive digital marketplace, businesses are constantly seeking cost-effective and sustainable strategies to enhance their online presence (Oleksiuk *et al.*, 2023; Ihnatenko *et al.*, 2023). SEO has emerged as a powerful tool, offering numerous advantages beyond just improving search rankings. From increasing brand visibility to reducing marketing costs, SEO plays a crucial role in driving long-term growth and customer engagement. Table 1 highlights the key advantages of using SEO for businesses.

SEO optimisation is crucial for various industries, especially those that rely heavily on online visibility and customer acquisition. Retail Industry, e-commerce, and service-based industries can benefit significantly from effective SEO strategies. The retail sector has undergone a substantial transformation with the shift to online platforms, making strong SEO practices essential for improving visibility and attracting customers. Optimised search strategies help businesses enhance their online presence, drive organic traffic, and improve user engagement. By integrating SEO with broader digital marketing efforts, companies can streamline operations, strengthen brand positioning, and create more effective customer acquisition strategies, ultimately contributing to business growth.

Table 1. Key competitive advantages of using SEO

Competitive advantage	Description
Brand visibility	About 60% of studies confirm that SEO helps maintain competitive advantage by optimising the customer journey and increasing brand visibility.
E-commerce Integration	Integrating SEO with e-commerce can increase operational efficiency by 15%-25% and helped companies grow their revenue by 20%.
Reduced Marketing Costs	Approximately 50% of studies show that using SEO helps companies reduce marketing costs by up to 15% due to organic search profitability.
Trust and Brand Loyalty	70% of studies show that improved visibility in search results not only increases traffic but also increases brand trust. Companies that rank high in search results tend to have higher levels of consumer trust, which leads to a 10%-25% increase in brand loyalty.

Source: prepared based on research data by G. Sechele *et al.* (2024)

E-commerce businesses depend on search engines to drive customer traffic. SEO strategies enhance organic rankings, which is crucial for engaging potential customers at every stage of their buying process. By utilising local SEO, service-oriented businesses can target particular geographic areas, enhancing their visibility to customers searching for services in those locations. Customised SEO strategies for specific services ensure that relevant information is readily available online, which helps improve both customer acquisition and retention. PPC is a highly effective and widely used digital marketing strategy. It enables advertisers to pay solely for clicks on their ads, ensuring cost-efficiency and precise targeting. As PPC technologies continue to advance, new tools and features are regularly introduced to optimise advertising campaigns.

The key advantages of PPC are as follows:

- Speed of results. PPC is one of the quickest methods to drive targeted traffic to a website. Contextual advertising can generate immediate impressions and clicks, but refining a campaign for consistent, cost-effective, and high-quality results requires time. It may take several months to optimise all aspects of the campaign entirely. PPC usefulness, PPC ease of use, and confirmation are directly responsible for satisfaction with PPC, attitude towards PPC, and continuous search intention (Rezaei *et al.*, 2024).
- Precise targeting. PPC targeting options allow businesses to refine their approach by focusing on language, location, demographics (such as age and gender), and specific times of day or week, ensuring advertisements reach the audience most likely to convert. Contextual advertising creates a level playing field, where small businesses have an equal chance of winning keyword bids and achieving high rankings in search results alongside larger companies. By selecting targeted keywords, optimising advertising campaigns and landing pages, and using advanced targeting features, small businesses can effectively compete in the marketplace.
- Budget flexibility. Campaigns can be tailored to suit budgets of any size, providing flexibility for businesses of all scales.
- Measurability and analytics. Contextual advertising offers a strong level of control and customisation, enabling companies to set budgets, target specific locations, and test different advertising creatives. Furthermore, it yields quick results, which are easy to track and analyse using various metrics and tools (Almestarihi *et al.*, 2024).

The key disadvantages are as follows:

- Need for regular investment. Running PPC campaigns without continuous monitoring and optimisation is inefficient. It is crucial to regularly review and adjust campaigns to achieve the desired results, investing more time and resources when necessary. Failing to track and optimise campaigns can result in inferior performance and wasted spending.
- Variability and price fluctuations. Properly setting up a PPC campaign is critical because it determines the cost efficiency and effectiveness of an advertising strategy. An incorrectly set-up campaign can quickly waste budget without achieving the desired outcomes. For example, if the keywords are poorly chosen, the advertisement may be shown to an untargeted audience that is not interested in the product. This reduces the conversion rate and leads to an increase in the cost of customer acquisition. Accurate targeting, seasonality, and the right region and time schedule help reach the right audience at the right time. Ad optimisation, relevant landing pages, and regular data analysis help to increase ROI (return on investment). Thus, properly setting up a PPC campaign ensures that business goals are achieved at a minimal cost.
- Ignoring due to inorganic advertising. Ignoring PPC ads due to their inorganic nature occurs when users perceive the advertisement as artificial, inauthentic, or irrelevant to their needs. The reasons may include excessive commercialisation of the text, inferior creative quality, irrelevant keywords, or inaccurate targeting. Furthermore, if the advertisement does not match the user's request or is too aggressive, it causes distrust in the brand. To avoid this, it is vital to create relevant, aesthetically pleasing, and clearly focused advertisements that look natural and meet user needs.

Contextual advertising is widely used in various business sectors, especially among small and medium-sized enterprises. Approximately 65% of these enterprises conduct pay-per-click campaigns to increase their online visibility and attract potential customers (Berry, n.d). According to I. Horodniak & S. Zinkova (2022), in Ukraine, medium-sized enterprises dominate in the use of PPC, accounting for about ~60% of all users. Since SEO and PPC are more interchangeable than complementary, the following metrics in Table 2 can help determine the most effective tool.

Table 2. SEO and PPC comparation

Metric	SEO	PPC
Click-Through Rate	17.45%	3.5%
Conversion rate	2.4%	1.3%
CTR/CR	7.27	2.7
ROI in example	429.2%	174%

Notes: Click-Through Rates (CTR) were calculated as the average between the CTR on the first and tenth page of a search result
Source: prepared based on research data by P. Stainton (2024), FirstPageSage (2025)

Table 2 illustrates how much more effective SEO is in converting customers than PPC. However, there are also intangible reasons why PPC continues to be a worthwhile investment. For example, contextual advertising allows trying out different keywords before spending months or years promoting them with SEO. Additionally, potential customers can see the target site in both organic and paid search results, for the same reason that it benefits businesses to be visible in both search results and social media. Thus, combining SEO and PPC usually makes sense. Table 3 compares the performance of SEO and SEM across several key performance indicators across industries using ANOVA-analysis.

Table 3. Dispersion analysis of SEO and PPC performance across industries

Metric	SEO F-Value	SEO P-Value	PPC F-Value	PPC P-Value
Organic Traffic	0.68	0.569	1.415	0.251
CTR	1.69	0.182	2.695	0.057
CR	1.238	0.307	3.165	0.033
Cost per click	0.345	0.793	0.122	0.947
ROI	1.193	0.323	0.442	0.724

Source: prepared based on research data by R. Arora & P. Tyagi (2024)

For most indicators, the P-Value is greater than 0.05, indicating the absence of statistically significant differences between SEO and PPC across industries. This suggests that these indicators do not show significant variation in performance across industries. However, for CR, the P-Value for PPC is 0.033, which is less than 0.05, indicating more significant differences in CR across industries. This suggests that CR varies significantly across industries, which may affect advertising spending strategies. Thus, while most indicators do not show significant variation, CR is more sensitive to industry differences, which may influence budgeting and campaign allocation strategies. Table 4 presents the difference in the scale of costs for implementing tools for businesses of various sizes.

Table 4. Comparison of SEO and PPC costs (in USD)

Instrument / Business size	Small	Medium	Large
SEO	1,500-3,500	3,000-7,000	10,000-25,000
PPC	1,000<	1,000-3,000	>10,000

Source: prepared based on research data by A. Shum (2025), M. Dejnak (2024)

Search engine optimisation is a slightly more expensive tool, but its effect is layered over time. However, such figures can vary depending on the goals, specific niche, level of competition, etc. For example, in more competitive areas, a larger SEO budget may be required to achieve the desired results. Other notable factors include the type of services, such as creative development, landing page optimisation, and analytics. Agencies may also add more costs for these services, which affects the total monthly cost.

DISCUSSION

The debate over choosing SEO or PPC as the primary digital marketing tool continues to be relevant due to their various advantages and disadvantages. SEO proponents emphasise its long-term benefits, such as generating stable organic traffic, increasing user trust, and reducing costs in the long term. PPC advocates, on the other hand, emphasise quick results, the ability to quickly test strategies, and achieve instant visibility in search engines. The controversy also arises from different approaches to budget allocation: SEO requires constant investment in creating quality content and technical optimisation, while PPC involves extensive advertising costs that do not have a long-term effect after the campaign ends. Moreover, there are differences in the interpretation of the relationship between these tools: some experts consider SEO as part of SEM, while others distinguish them as independent approaches. This emphasises the need for a detailed analysis of business goals and market conditions for an informed choice of the best strategy.

R. Ranjpour (2024) noted that the use of SEM strategies instead of one of the factors is not a universal solution. The researcher presented the circumstances that must be considered when choosing to use a comprehensive SEM strategy. Marketers must be ready to allocate funds systematically, because the PPC effect is almost not preserved over time. Marketers must have a proper understanding of the tools and the ability to configure the combined SEO/PPC process. Many factors must be accounted for, such as keyword targeting, quality indicators, return on investment (ROI), conversion rate, etc. It is desirable to have a dedicated team for proper management of SEM processes. Ranjpour emphasised the need for preliminary analysis and planning to determine exactly those tools of the SEM complex that would avoid unnecessary costs and problems. This approach argues that it is not always advisable to resort to the entire toolkit, it is often advisable to focus on individual elements.

According to K. Kumar *et al*. (2024), SEO increases organic traffic, improves user experience, and increases customer satisfaction by increasing a website's visibility and ranking in search engines. The researchers noted that a company must implement a thorough digital marketing strategy that takes advantage of multiple approaches to satisfy customers and build lasting loyalty. Contextual advertising also improves customer satisfaction by providing personalised advertising on platforms such as Google Ads, thereby facilitating instant visibility and contact with potential customers with a strong level of purchase interest.

H. Ibrahim *et al*. (2024) performed a comparative analysis of existing modern methods, highlighting the advantage of a combined SEO and SEM approach, especially in the competitive e-commerce environment where dynamic ranking algorithms create constant challenges. According to the researchers, "a combined approach to SEO and SEM provides a more comprehensive solution to increase product visibility and sales on e-commerce platforms, justifying its superiority over other methods used on simple websites and e-commerce platforms". SEO and SEM can outperform conventional one-way methods, offering solid solutions for businesses that plan to maximise their digital presence. The researchers noted that the combined use of these tools leads to a 5% increase in conversion rate.

According to C. Martin (n.d.), SEO tends to provide a 25% greater ROI compared to PPC. Furthermore, I. Burban's (2025) data revealed that the ROI for SEO was calculated to be five times greater than that of PPC. The click-through rate for SEO was significantly higher than PPC, with SEO at 17.45% compared to PPC's 3.5%. This indicated that organic search results were much more likely to attract clicks than paid advertisements. Additionally, the conversion rate for SEO was also greater at 2.4% compared to PPC's 1.3%, meaning visitors coming from organic search were more likely to convert into customers. When comparing the efficiency of the CTR and CR together, the ratio (CTR/CR) was much higher for SEO (7.27) than for PPC (2.7), highlighting SEO's better overall performance in driving both traffic and conversions. Lastly, the example with ROI showed that SEO brought in a much higher return at 429.2%, compared to PPC's 174%, further supporting the idea that SEO tends to offer a stronger ROI. As reported by I. Ugolkov *et al*. (2020), a complex use of SEO and PPC may result in 709% ROI on average. Thus, if possible, a combined use of these two strategies should be given preference to achieve better outcomes.

On the other side of the debate, apart from the effectiveness of the combination, is the understanding of the concept of SEM. Some researchers specifically include SEO in SEM, because both strategies are aimed at improving the visibility of the site in search engines. They form a part of an overall search marketing strategy, but with broad approaches: SEO focuses on organic (unpaid) traffic through site optimisation, while PPC offers the use of paid advertising to attract traffic. Thus, in this approach, SEO is viewed as part of a larger strategy, where both methods complement each other. J. Hardwick (2024) noted that "the main difference between search engine optimisation (SEO) and search engine marketing (SEM) is that SEO focuses on optimising a website for organic search traffic, while SEM includes both organic search and paid advertising to attract traffic".

A. Erdmann *et al*. (2022) put SEO and SEM side by side, because they still have different goals and methods. SEO is focused on long-term results, contributing to organic traffic growth, while SEM brings quick results through paid instruments and campaigns. This allows separating organic and paid promotion and provide a clearer understanding of their interaction within the framework of the overall marketing strategy. R. Luttrell & A. Wallace (2025) separated SEO and SEM, but analysed them in relation to each other, especially in the context of improving public relations strategies. The researchers explained both approaches: SEO through improved keyword analysis, content automation, and personalisation, and SEM through improved targeting algorithms and automated advertising auctions. Therefore, the distinction between SEO and SEM depends on whether

SEO is considered one of the elements of SEM or a separate approach to organic traffic attraction within the framework of the overall search marketing strategy.

Unlike previous studies that examined SEO and PPC individually, the present study adopted an integrative approach by juxtaposing the two strategies in the context of search engine marketing. The study brought to the fore not only the measurable impacts such as visibility and conversion rate enhancement but also the qualitative impacts such as enhanced brand confidence and strategic adaptability. Additionally, while earlier studies tended to overlook the nuances introduced by industry conditions and company size, the present study factored these in to offer a more comprehensive approach. Furthermore, the study covered specific cost structures and budget allocation challenges, analysing how these strategies perform across different company sizes and industry conditions – factors often overlooked in earlier studies. By addressing these aspects, the present study offered a more comprehensive understanding of the interplay between SEO and PPC, ultimately providing a robust framework for optimising digital marketing efforts in diverse business environments.

CONCLUSIONS

SEM strategy optimisation is a set of digital marketing elements that ensure increased visibility, conversions, and customer satisfaction. To achieve the best results, it is necessary to obtain both the long-term short-term benefits of SEO and the short-term opportunities of PPC. SEO helps to create a sTable base of organic traffic by increasing positions in search engines, improving click-through rate and return on investment, which allows businesses to reduce paid advertising costs over time. At the same time, PPC is indispensable for getting results quickly, especially in cases where it is necessary to test keywords, adapt to changes, or provide instant visibility to the target audience. The statistical indicators in this study reveal clear performance differences between SEO and PPC. Specifically, the average click-through rate for SEO was 17.45% compared to only 3.5% for PPC, while the conversion rate was 2.4% for SEO versus 1.3% for PPC. This resulted in a CTR/CR ratio of 7.27 for SEO, significantly higher than the 2.7 observed for PPC, underscoring SEO's effectiveness in converting clicks into meaningful engagement. Furthermore, the return on investment (ROI) for SEO was calculated at 429.2%, which was substantially higher than the 174% achieved by PPC. ANOVA analysis provided further insights: although the p-values for organic traffic and CTR differences for SEO exceeded the conventional significance level, the p-value for the PPC conversion rate was 0.033, suggesting statistically significant variability in that metric across industries. In contrast, both cost per click and ROI did not exhibit significant differences in variance for either strategy. These statistics strongly favoured SEO over PPC in the long-term performance of sustainable digital marketing performance. Combining SEO and PPC can produce a 709% average ROI. This suggested that combining the two, as opposed to using them individually, can boost overall marketing performance substantially. By pairing the long-term ROI of SEO with the short-term boost of PPC, companies can maximise their visibility, build greater engagement, and drive better bottom-line performance. However, despite its integrative nature, the study had certain limitations, such as the lack of longitudinal data as well as the need to further explore future digital marketing trends. Further studies can expand on these findings by incorporating real-time data and extending the study to other marketing channels, thus developing an even deeper insight into the dynamic relationship between SEO and PPC.

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CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

REFERENCES

[1] Almestarihi, R., Ahmad, A.Y.A.B., Frangieh, R.H., Abu-AlSondos, I.A., Nser, K.K., & Ziani, A. (2024). Measuring the ROI of paid advertising campaigns in digital marketing and its effect on business profitability. *Uncertain Supply Chain Management*, 12(2), 1275-1284. doi: 10.5267/j.uscm.2023.11.009.

[2] Arora, R., & Tyagi, P. (2024). A comparative study on search engine optimisation and search engine marketing: Optimising strategies in business growth. *The International Journal of Convergent Research*, 1(1), 101-107.

[3] Berry, S. (n.d). *11 PPC FAQs that every new advertiser should ask*. Retrieved from https://www.webfx.com/blog/marketing/ppc-faq/?ajs_aid=undefined.

[4] Burban, I. (2025). *PPC vs SEO: Differences, pros, cons & how to measure*. Retrieved from https://is.gd/glH3iC.

[5] Çırakoğlu, F.S., & Koşaner, Ö. (2024). Linguistic insights into high-quality content for SEO: Optimising high-quality content with Grice's conversational maxims. *Telematics and Informatics Reports*, 16, article number 100169. doi: 10.1016/j.teler.2024.100169.

[6] Cuijten, N., Wongpun, S., Buaprommee, N., Suwannahong, R., & Inmor, S. (2024). Exploring the digital marketing potential and needs for digital marketing capabilities of service sector MSMEs in Thailand. *Journal of Business Economics and Management*, 25(5), 1052-1074. doi: 10.3846/jbem.2024.22470.

[7] Dehlin, M., & Björnfot, Q. (2023). Comparing the return on investment of search engine optimisation and pay-per-click marketing. (Bachelor's thesis, Örebro School of Business, Örebro, Sweden).

[8] Dejnak, M. (2024). *What is the PPC Cost Formula?* Retrieved from https://landingi.com/ppc/cost/.

[9] Erdmann, A., Arilla, R., & Ponzoa, J.M. (2022) Search engine optimisation: The long-term strategy of keyword choice. *Journal of Business Research,* 144, 650-662. doi: 10.1016/j.jbusres.2022.01.065.

[10] FirstPageSage agency. (2024). SEO vs. PPC statistics: 2025 conversion rate. Retrieved from https://firstpagesage.com/reports/seo-vs-ppc-statistics-conversion-rates-compared-fc/.

[11] Google Economic Impact. (n.d.). *Methodology of Google*. Retrieved from https://economicimpact.google/methodology/.

[12] Hardwick, J. (2024). SEO vs. SEM: What's the difference? Retrieved from https://surl.li/jlfigi.

[13] Hien, N.N., & Nhu, T.N.H. (2022). The effect of digital marketing transformation trends on consumers' purchase intention in B2B businesses: The moderating role of brand awareness. *Cogent Business & Management*, 9(1), article number 2105285. doi: 10.1080/23311975.2022.2105285.

[14] Horodniak, I., & Zinkova, S. (2022). Analysis of the PPC services market in Ukraine. *Marketing and Digital Technologies*, 6(2), 62-72. doi: 10.15276/mdt.6.2.2022.5.

[15] Huacre, K., Daza, A., & Mejia, E. (2021). E-commerce system for the sales process in the company: A systematic review. *Journal of System and Management Sciences*, 11(4), 113-126. doi: 10.33168/jsms.2021.0406.

[16] Ibrahim, H., Rahmah, M., Raza, M.A., & Fauziah, Z. (2024). A dual-focused approach to e-commerce product ranking: Leveraging search engine optimisation and search engine marketing. *Library Progress International*, 44(3), 4918-4929.

[17] Ihnatenko, M., Kotsur, V., & Aranchii, V. (2023). Development of e-commerce in the context of digitalisation of social life. *University Economic Bulletin*, 18(3), 84-90. doi: 10.31470/2306-546X-2023-58-84-90.

[18] Kumar, K., Irfana, S., Arya, T., Solomon, R., Kapoor, R., & Sagar, R. (2024). Driving customer satisfaction through effective digital marketing strategies. *Journal of Informatics Education and Research*, 4(2), 1759-1764.

[19] Luttrell, R., & Wallace, A.A. (Eds.). (2025). *Public relations and the rise of AI* (1st ed). New York: Routledge. doi: 10.4324/9781032671482.

[20] Marchuk, O., & Kushnir, T. (2024). Search engine optimisation and its place in internet marketing. *Efektyvna Ekonomika*, 8. doi: 10.32702/2307-2105.2024.8.83.

[21] Martin, C. (n.d.). *SEO vs. PPC statistics in 2025: Key data-driven insights revealed*. Retrieved from https://surl.li/wwxxsv.

[22] Oleksiuk, O., Shafalyuk, O., & Tashchenko, A. (2023). Information-time factors of the customer experience management efficiency in marketing and commerce of enterprises. *Management and Business*, 1(2), 201-214.

[23] Osan, A. (2023). Search engine optimisation (SEO) and search engine marketing (SEM). In İ.E. Tarakçı & R. Aslan (Eds.), *The essentials of today's marketing 2* (pp. 7-24). İstanbul: Efe Academy Publishing.

[24] Ranjpour, R. (2024). The significant role of SEO in effective web marketing: A critical literature review. In *Association of marketing theory and practice proceedings 2024*. Georgia: Georgia Southern University.

[25] Rezaei, S., Amin, M., & Herjanto, H. (2024). Pay-per-click (PPC) advertising and continuous banking service intentions. *Journal of Financial Services Marketing*, 29(4), 1542-1558. doi: 10.1057/s41264-024-00282-8.

[26] Saeed, Z., Aslam, F., Ghafoor, A., Umair, M., & Razzak, I. (2024). Exploring the impact of SEO-based ranking factors for voice queries through machine learning. *Artificial Intelligence Review*, 57(6), article number 144. doi: 10.1007/s10462-024-10780-9.

[27] Sechele, G., Rabedzwa, G., Nongayo, S., & Thango, B. (2024). Systematic review on SEO and digital marketing strategies for enhancing retail SMEs' performance. *Preprints*. doi: 10.20944/preprints202410.1715.v1.

[28] Shahzad, A., Nawi, N.M., Hamid, N.A., Khan, S., Aamir, M., Ullah, A., & Abdullah, S. (2017). The impact of search engine optimisation on the visibility of research paper and citations. *JOIV – International Journal on Informatics Visualisation*, 1(4-2), 195-198. doi: 10.30630/joiv.1.4-2.77.

[29] Shum, A (2025). *How much does SEO cost in 2025?* Retrieved from https://seoprofy.com/blog/seo-pricing/.

[30] Stainton, P. (2024). *Debunking the SEO vs. PPC bebate: What you need to know*. Retrieved from https://agencyanalytics.com/blog/seo-vs-ppc.

[31] Symonenko, K. (2024). *Global e-commerce: Key figures and trends in e-commerce 2024*. Retrieved from https://rau.ua/novyni/trendi-e-com-2024/?utm_source.

[32] Ugolkov, I., Karyy, O., Skybinskyi, O., Ugolkova, O., & Zhezhukha, V. (2020). The evaluation of content effectiveness within online and offline marketing communications of an enterprise. *Innovative Marketing*, 16(3), 26-36. doi: 10.21511/im.16(3).2020.03.

[33] Volkova, N., Kuzmuk, I., Oliinyk, N., Klymenko, I., & Dankanych, A. (2021). Development trends of the digital economy: E-business, e-commerce. *IJCSNS International Journal of Computer Science and Network Security*, 21(4), 186-198. doi: 10.22937/IJCSNS.2021.21.4.23.

Олег Марчук

Магістр
Львівський національний університет імені Івана Франка
79000, вул. Університетська, 1, м. Львів, Україна
https://orcid.org/0009-0001-8006-4789

Тарас Кушнір

Кандидат економічних наук, доцент
Львівський національний університет імені Івана Франка
79000, вул. Університетська, 1, м. Львів, Україна
https://orcid.org/0000-0003-1643-2273

Удосконалення стратегії маркетингу в пошукових системах: Балансування довгострокових інвестицій у пошукову оптимізацію з негайними результатами з оплатою за клік

Анотація. У цьому дослідженні розглянуто актуальність інтеграції методів залучення органічного та платного трафіку для підвищення видимості та прибутковості бізнесу. Метою цього дослідження було визначити найкращий баланс між довгостроковими інвестиціями в пошукову оптимізацію (SEO) та негайними результатами, які забезпечує реклама з оплатою за клік (PPC). У дослідженні використовувалися методи порівняльного аналізу, теоретичного синтезу та розгляду практичних випадків впровадження пошукового маркетингу в електронній комерції. Результати показали, що SEO створює міцну основу для органічного трафіку, зменшуючи залежність від платної реклами та забезпечуючи високу рентабельність інвестицій (ROI) у довгостроковій перспективі. Водночас, PPC-реклама забезпечує швидку реакцію ринку, ефективне тестування ключових слів та миттєву видимість продуктів або послуг. Комбінований підхід до пошукового маркетингу, що інтегрує SEO та PPC, виявився найефективнішим для підвищення коефіцієнта конверсії, покращення взаємодії з користувачами та підвищення задоволеності клієнтів. Практична цінність цього дослідження полягає у формулюванні стратегічних принципів налаштування пошукового маркетингу для мінімізації витрат, підвищення конкурентоспроможності та досягнення сталого зростання. Ефективний пошуковий маркетинг вимагає індивідуального підходу, який враховує характеристики ринку, специфіку бізнесу та фінансові ресурси. Ці результати надали практичну інформацію для розробки маркетингових стратегій для використання в різних галузях

Ключові слова: онлайн-видимість; стратегія ранжування в пошуковій видачі; платна пошукова реклама; ефективність реклами; просування веб-сайту; органічний трафік

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Zhao Jing*
Postgraduate Student
Sumy National Agrarian University
40000, 160 Herasym Kondratiev Str., Sumy, Ukraine
Administrative Staff
Huangshan University
245041, Dai Zhen Lu, Huangshan, China
https://orcid.org/0009-0008-1686-2189

Alina Brychko
Associate Professor
Sumy National Agrarian University
40000, 160 Herasym Kondratiev Str., Sumy, Ukraine
https://orcid.org/0000-0003-4902-1403

A review of differences between American and Chinese corporate culture based on CiteSpace software

Abstract. The USA and China, as the world's two largest economies, exhibit distinct business models that are directly reflected in their corporate cultures. The purpose of this study was to examine the significant differences between Chinese and American corporate cultures from two perspectives: academic achievements and the cultural status of Fortune 500 companies. Among the Fortune 500 companies, American firms tend to emphasise "customer satisfaction" and "employee well-being", while Chinese enterprises place greater emphasis on "customer focus" but may lack sufficient attention to "employee welfare", instead promoting "employee dedication". As for academic achievements, the quantity and focus of academic publications in the USA and China exhibit significant similarities, and both advocate corporate cultures of the American enterprise in the Forbes list. A notable discrepancy was found between the cultural model of Chinese companies ranked by Forbes and their academic accomplishments. The list of top Chinese firms is predominantly large state-owned enterprises, characterised by a corporate culture with pronounced political traits. Politically and economically, the stable labour environment, stability, and excellent benefits provided by state-owned enterprises have resulted in low employee turnover rates. Still, this stability has also led to a widespread neglect of employees' needs by management. Culturally, the enduring influence of Confucianism has entrenched an internal hierarchy within enterprises, leading employees to be conservative in expressing individual opinions and proposing innovative ideas, often achieving career goals through diligent work and personal sacrifice. Generation Z has progressively emerged as the predominant force within the corporate workforce, placing significant emphasis on personal freedom and value resonance. The current enterprise culture in China is encountering increasingly formidable challenges, rendering the reform of corporate culture both urgent and necessary

Keywords: corporate operation; employees; customers; state-owned enterprises; Confucianism

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*Corresponding author

INTRODUCTION

Corporate culture constitutes an intricate and multi-faceted system encompassing the core values, governance framework, employee conduct norms, and external representation of an enterprise as manifested in its operational practices. Since its inception, corporate culture has been recognised as a pivotal pathway to achieving success in modern management. It is not a static or isolated construct but rather evolves dynamically under the influence of various internal and external factors. As the world's two largest economies, the USA and China are home to numerous large enterprises. Influenced by distinct external environmental factors, these countries have developed unique corporate cultures, particularly in terms of employee care. Notably, employees serve not only as carriers and embodiments of corporate culture but also play an increasingly critical role in the development and success of enterprises. A thorough analysis of the underlying differentiating factors shaping American and Chinese corporate cultures can provide valuable insights for managers in building effective corporate cultures, facilitating more scientifically sound management practices, enhancing employee satisfaction and organisational commitment, and ultimately strengthening the core competitiveness of enterprises.

Since its inception, corporate culture has been widely recognised as a pivotal element in the success of modern management. It positively influences social responsibility, mitigates trade risks, enhances resilience to external shocks, boosts employee cohesion, and shapes employee behaviour. According to K. Li *et al*. (2021), a survey of 2,894 American companies revealed that despite the adverse impact of COVID-19 on business operations, firms with robust corporate cultures exhibited significantly superior performance, characterised by higher levels of employee innovation and sales performance. H. Mishchuk *et al*. (2022) classified corporate culture as a critical form of social capital, which substantially affects a firm's sustainable competitiveness. S. Cheng *et al*. (2023) analysed data from 2,818 listed Chinese companies and concluded that a strong corporate culture can enhance a company's risk resistance during the US-China trade war, particularly for private enterprises. A. Polyanska *et al*. (2019) evaluated Ukrainian gas transportation companies using the McKinsey 7S model and found that corporate culture is shaped by employee behavioural norms and values grounded in cultural, ethical, material, and spiritual dimensions, fostering creative vitality and entrepreneurial spirit. Employees, as the most dynamic production factor, constitute the core human resources driving enterprise innovation and development. K. Piwowar-Sulej (2021) highlighted that capable and motivated employees are crucial for enterprise development; Y. Lu *et al*. (2023) emphasised that safeguarding employee interests is central to achieving an enterprise's human and social objectives, thereby laying the foundation for attaining other goals.

B.A. Kurdi *et al*. (2020) examined the relationship between employee satisfaction and customer satisfaction across five key variables, revealing a significant causal link between the two. Specifically, positive employee experiences were found to directly influence customer satisfaction, which in turn impacts enterprise competitiveness. Employee attitudes and behaviours are significantly shaped by corporate management practices, and high employee turnover can have a detrimental effect on both management strategies and overall competitiveness (Khan *et al*., 2020). Sagacious enterprise leaders have shifted from managing employees through rigid rules and regulations to a more nuanced approach. They now place significant emphasis on understanding employee sentiments and behaviours, implementing cultural management strategies that align corporate values with those of the employees. This fosters a multi-dimensional synergy between the organisation and its workforce (Xia *et al*., 2023). A robust corporate culture embodies shared values and beliefs among managers and employees, positively influencing performance, attitudes, behaviours, productivity, and long-term development (Cherian *et al*., 2021). Corporate culture not only serves as a foundation for human resource management but also acts as an intermediary between HR practices and corporate performance, further enhanced by effective resource management, thus improving employee experience and behaviour. Against the backdrop of turbulent world situation and trade war, the two largest economies, the American and China, have shown a trend of anti-globalisation after 2017, and for enterprises operating in a highly competitive global economic environment, turbulence in the external operating environment is inevitable (Itakura, 2020).

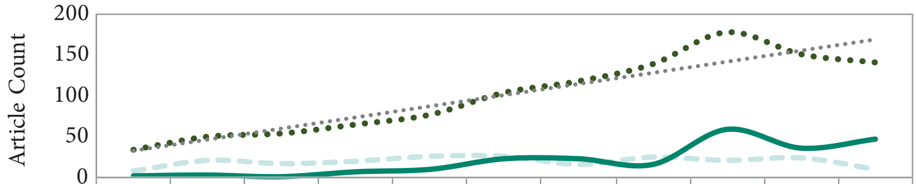
A strong corporate culture can not only handle shocks such as trade wars and COVID-19 but also increase employee satisfaction and organisational commitment, building a strong human resource base. However, the corporate cultures of these two economies are facing different environmental impacts, which have become typical corporate culture characteristics of their own. The purpose of this study was to analyse the differences between Chinese and American corporate cultures, specifically in employee management, from the academic achievements and the data of Forbes 500 companies, and to analyse the causes of such differences from the aspects of politics, economic models and culture. The pattern of the world may become worse. In this contrast, finding the advantages and disadvantages of different corporate cultural characteristics in different environments and learning from each other can enable enterprises to meet the impact of the external environment with a stronger attitude.

MATERIALS AND METHODS

This study was of a survey nature. The academic articles retrieved for this study were obtained from the Web of Science database, covering the period from 2014 to 2024. The topic used for retrieval was "corporate culture". Data analysis was conducted using CiteSpace 6.4 R1 Advanced Software, and further exploration focused on identifying differences between Chinese and US corporate cultures. These differences were analysed by considering cultural background and development factors. To retrieve relevant articles, the Web of Science Core Collection database was selected, and a search was performed using the topic "corporate culture" within the specified timeframe (January 1, 2014-December 31, 2024). The main types of articles included in this study were articles and reviews. Articles such as letters, editorial materials, summaries of meetings, book chapters, recensions, and online publications that were irrelevant or incomplete were excluded. Finally, the duplicate documents were removed using the duplicate function in CiteSpace 6.4 R1 Advanced Software. A total of 1,111 limited articles were imported. The documents included were exported from Web of Science in TXT format and named as Download_CC, which were then imported into the software for data analysis. The software was set with TopN = 50, TopN% = 10%, time period from 2014 to 2024, and time slice as 1 year. The processed data were analysed by year, country, keyword clustering, keyword timeline, keyword heat map, and keyword frequency. The Fortune Global 500 List (n.d.) for different years was used to compare Chinese and US companies. This helped to form the authors' vision of the differences in corporate culture of the two different countries on which this study was focused.

RESULTS AND DISCUSSION

With the theme of "corporate culture", a total of 1,111 valid data were obtained from global academic articles. Figure 1 presents the annual publication analysis and trend line of valid articles. The analysis revealed that international research papers on corporate culture have generally been on the rise, with an average of 101 published per year. Since 2015, the research papers on corporate culture in the United States have reached a relatively sTable state, while the research of Chinese scholars is in line with the overall trend of the world and exceeds the average frequency. This analysis suggests that the American has a mature corporate culture, operating system and academic framework, which has developed steadily, and there is not much interest in academia. With the global promotion of soft management methods into the field of corporate culture, many countries, including China, have begun to pay attention to the study of this topic.



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
All	34	50	54	65	77	104	118	139	178	151	141
America	8	21	17	20	26	26	16	25	21	24	10
China	2	3	1	7	10	23	23	16	59	36	47

Figure 1. The annual publication volume of effective articles on "corporate culture" in different regions from 2014 to 2024
Source: compiled by the authors of this study

A comprehensive data information window was obtained for a total of 86 nodes (countries or regions), with the results presented in Figure 2 and Table 1. Among these nodes, the United States, China, and the United Kingdom rank in the top three in terms of the frequency of paper publication. Despite England having a significantly lower number of published articles (88) compared to the US (214) and China (227), it exhibits the highest centrality value (0.33). This indicates that research findings from this region are cited most frequently and contribute significantly. Conversely, both the US and China have comparable publication frequencies and centrality values. American and Chinese scholars constitute the two largest cohorts globally engaged in studying corporate culture, which further underscores the significance accorded by enterprises and research institutions in both countries to this field of study. Keywords play a crucial role in research articles as they directly reflect the main body and content of the study, provide clear focus on the research status, and capture the trending research directions globally and regionally.

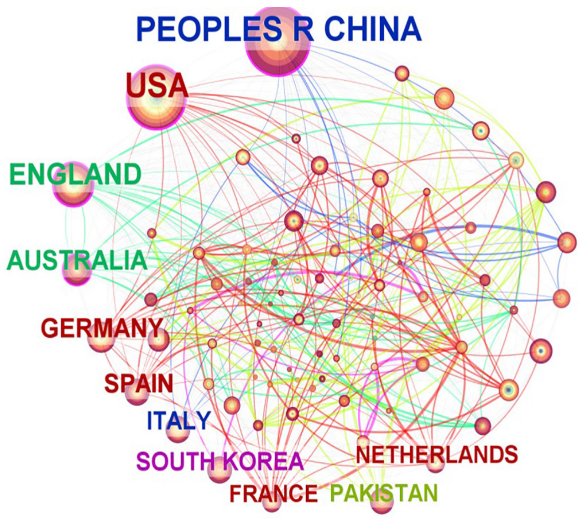


Figure 2. Major countries and regions with research results on corporate culture
Source: compiled by the authors of this study

Table 1. Frequency and centrality of published articles on corporate culture in major countries and regions in the world

Country	Frequency	Centrality
PEOPLES R CHINA	227	0.29
USA	214	0.26
ENGLAND	88	0.33
AUSTRALIA	57	0.15
GERMANY	52	0.04
SPAIN	44	0.03
ITALY	42	0.09
SOUTH KOREA	41	0.04
FRANCE	32	0.07
NETHERLANDS	31	0.09
PAKISTAN	31	0.04
ROMANIA	27	0
MALAYSIA	27	0.04
TAIWAN	25	0.04
INDIA	24	0.04

Source: compiled by the authors of this study

Keywords are crucial in research papers as they directly reflect the core content and essence of the research, delineate the focal points, and capture both global and regional research trends (Fig. 3). In numerous articles, many keywords with the same meaning are written in different forms, such as "corporate social responsibility" and "CSR" being analysed separately, and the same is true for "corporate culture" and "organisational culture." Therefore, all major keywords were operated with synonym merging. Figure 4 shows the timeline and heatmap views of keyword clustering in research articles on corporate culture. The chart demonstrates that scholars around the world have mainly focused on 11 themes in corporate culture research, including "ESG performance," "sufficiency economy," "circular economy," "corporate social responsibility," "Confucian culture," etc. Among these themes, the first four mainly reflect the social and philanthropic nature of enterprises, which are particularly valuable in today's increasingly turbulent world. The fifth theme, "Confucian culture," represents a distinctive regional culture that serves as the predominant value system in East and Southeast Asia. This cultural framework emphasises the pursuit of moderation and harmony in all affairs to foster equilibrium and stability among individuals, enterprises, and society. In many instances, this may require subordinating personal interests for the greater good, which contrasts sharply with the values prevalent in Europe and the US. In the ranking of keyword clustering of academic achievements in the US and China (Table 2), apart from the shared focus on corporate social attributes, American researchers pay greater attention to enterprise innovation, while Chinese scholars are more concerned about sustainable development.

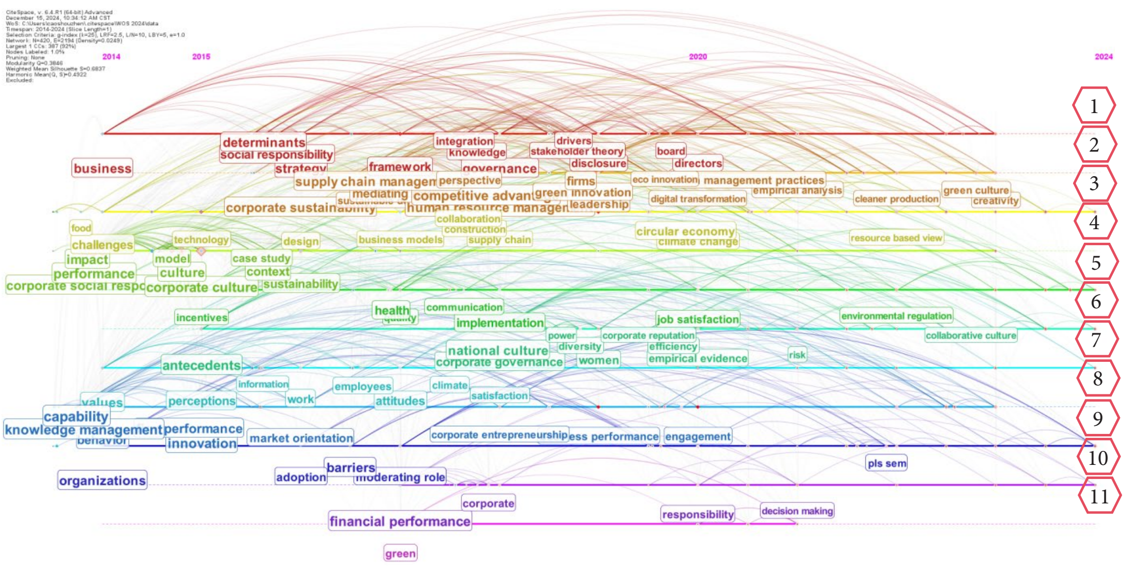


Figure 3. The centroid ranking of keywords cluster analysis in the world's academic articles
Source: compiled by the authors of this study

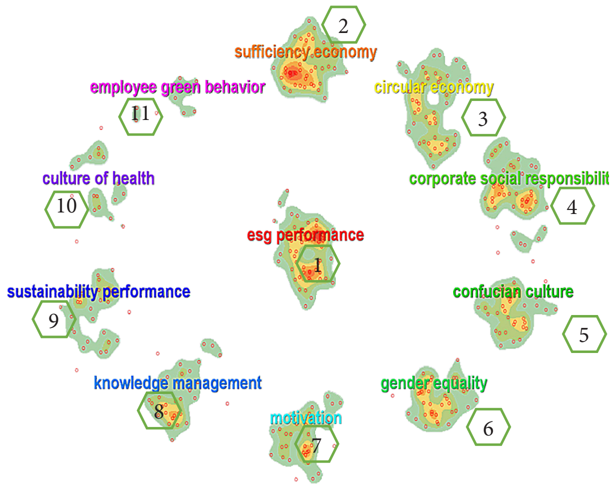


Figure 4. Timeline and heatmap views of keyword clustering in research articles on corporate culture
Source: compiled by the authors of this study

The analysis of research results from the world, the US, and China is presented in Tables 3, 4, and 5, respectively. The top five keywords in Chinese research articles are "corporate social responsibility," "performance," "impact," "management," and "organisational culture." This ranking aligns with global trends, with corporate social responsibility exhibiting significant Centrality strength. This implies that enterprises should not only prioritise profits and legal responsibilities towards shareholders and employees but also assume responsibilities towards consumers, communities, and the environment. Corporate social responsibility necessitates surpassing traditional profit-centric goals by emphasising human values during production processes while contributing to environmental sustainability, consumer welfare, and societal well-being. Although "corporate social responsibility" ranks second in terms of keyword frequency in America research articles; however, it is noteworthy that "culture" and "corporate culture" hold the highest Centrality value. Amongst these top five keywords are two related to culture which also possess high centrality values. This indicates that the American studies on corporate culture place greater emphasis on exploring its intrinsic nature. Each enterprise possesses unique cultural accumulation characterised by distinct personality traits determined by factors such as production methods, operational practices management approaches traditions goals employee qualities internal/external environments. The US has many world-leading advanced enterprises, which also have world-renowned corporate cultures and development models that are imitated by enterprises in other regions. This also provides American scholars with a wealth of research cases and corresponding corporate cultural confidence.

Table 2. Clustering analysis of keywords in American and Chinese academic articles

Country	Clustering keyword rankings
USA	(1) content configuration analysis; (2) corporate culture; (3) innovation culture; (4) corporate social responsibility; (5) national culture.
China	(1) behaviour; (2) corporate social responsibility; (3) sustainable development; (4) national culture; (5) implications for corporate sustainability.

Source: compiled by the authors of this study

Table 3. The statistical findings of keyword frequency and centrality in global corporate culture research results

Keywords	Frequency	Centrality
corporate social responsibility	219	0.07
performance	147	0.06
corporate culture	121	0.07
impact	118	0.04
management	92	0.04
culture	89	0.07
innovation	64	0.05
strategy	60	0.04
model	60	0.02
corporate sustainability	56	0.04

Source: compiled by the authors of this study

Table 4. The statistical findings of keyword frequency and centrality in research on corporate culture in the United States

Keywords	Frequency	Centrality
corporate culture	26	0.36
corporate social responsibility	22	0.37
impact	21	0.14
culture	19	0.31
performance	17	0.15
management	16	0.23
culture of health	7	0.13
model	6	0.04
governance	5	0.04
company	5	0.05

Source: compiled by the authors of this study

Table 5. The statistical findings of keyword frequency and centrality in research on corporate culture in China

Keywords	Frequency	Centrality
corporate social responsibility	58	0.21
performance	49	0.1
corporate culture	43	0.18
impact	43	0.11
management	28	0.11
firm performance	23	0.11
strategy	20	0.06
culture	18	0.11
green innovation	17	0.07
model	15	0.1

Source: compiled by the authors of this study

To investigate the stage development of corporate culture research, keyword emergent detection was conducted using CiteSpace software. The γ value was set at 0.5 with a yearly interval of 1 year. Figures 5 and 6 present the results, revealing that there were 12 emergent keywords in America academic achievements and 11 emergent keywords in China's. By comparing the data depicted in the figures, it becomes evident that apart from common keywords related to corporate social responsibility such as "climate change", "social responsibility", and "governance", the US particularly emphasise more concrete and detailed aspects of social responsibility. Notably, "capability" concerning employees emerged in America as early as 2014 while China's research on its employees commenced much later with corresponding keywords appearing only in 2019 and subsequently in 2021 respectively. These emergent keywords primarily focus on enterprise development itself which fundamentally distinguishes them from those observed in America.

Figure 5. Emergent detection of keywords in the Unites States
Source: compiled by the authors of this study

Figure 6. Emergent detection of keywords in China
Source: compiled by the authors of this study

In the 2024 Fortune Global 500 List, Chinese companies constitute 29.0% (145) of the total entries, while American companies account for 27.2% (124). Enterprises from both countries are closely interconnected and play a pivotal role in the global economic landscape. L. Du (2023) used AntConc software to analyse high-frequency terms related to corporate culture during 2019-2021 for both Chinese and US companies. Among the most used terms by Chinese enterprises, there was no explicit mention of employee care. However, through extensive promotional efforts, these enterprises emphasised the enhancement of employee engagement and advocated for employee dedication. This contrasts sharply with the focus observed in American corporations.

To summarise, the concepts of "corporate social responsibility," "employee care," and "corporate social responsibility" highlighted in the relevant articles on America corporate culture exhibit a high degree of similarity to corporate culture of Forbes list. However, there are noTable differences when compared to Chinese corporate culture. Chinese scholars also emphasise "corporate social responsibility" and "employee care" in their published findings. Nevertheless, Chinese companies listed in Forbes prioritise aspects such as "employee ethics," "employee dedication," and a customer-centric approach within their corporate culture, which significantly diverges from mainstream published findings.

In September 2023, the President of the United States Joe Biden personally visited Detroit to show support for the auto workers' strike initiated by the United Auto Workers union. In contrast, China witnessed numerous instances where enterprises were exposed for coercing employees into working overtime or disguising layoffs. A survey by C. Hu *et al.* (2024) comparing CEO letters from both countries revealed that interactive meta discursive nouns occurred twice as frequently in American discourse than in Chinese discourse, indicating greater efforts invested by the US companies towards employee cohesion. American large enterprises place significant emphasis on prioritising both "employees" and "customers." Conversely, Chinese large enterprises regard placing customers at a supreme position while praising employee dedication.

Corporate culture is influenced by a multitude of factors, including regional political characteristics, cultural background, industry type, and technological advancement – all of which exhibit major differences between China and the US. As a global leader in technology and economics, the US plays a dominant role in academic research on corporate culture. While there are some differences in academic achievements in corporate culture between the US and China, these discrepancies are relatively minor. However, a noTable disparity exists between the academic research on corporate culture in China and the actual corporate culture observed among Forbes-listed companies in the region, particularly concerning employee care. Compared to Chinese scholars, international counterparts do not exhibit a significant gap in research level or focus. Business serves as a microcosm of society, and as the world's second-largest economy, China's rapid development has demonstrated a unique pattern within its political system and cultural framework – profoundly influencing the corporate culture and operational models adopted by large Chinese enterprises. Consequently, a marked divergence has emerged in academic research focused on corporate culture.

As for the political system and economic structure, a defining feature of Chinese enterprises is the significant presence of state-owned enterprises (SOEs). Specifically, within the Fortune Global 500 List, large SOEs hold a substantial proportion. As of 2024, there were 90 Chinese SOEs on this list, accounting for 62.1% of all Chinese enterprises listed. K.J. Lin *et al.* (2020) noted that much of the academic research on SOE operations was based on Chinese samples. The corporate culture and core values of these SOEs exhibit unique characteristics, notably the politicisation of corporate culture. The political nature of SOE executives is widely recognised; some studies have likened it to a "revolving door" phenomenon where executives move between political bodies, government positions, and SOEs to advance their careers (Lin, 2017). C.A. Holz (2015) highlighted that the political dimension of Chinese SOEs has been widely acknowledged, often leading to their managers being perceived as "quasi-officials" or "state-owned enterprise businessmen" rather than conventional professional managers. This distinction applies particularly to chairpersons and chief executives of central SOEs. This phenomenon is not unique to China; K. Szarsec *et al.* (2020) surveyed approximately 12,000 joint-stock companies in Poland and found that changes in management and supervisory board members in SOEs are more frequent than in private enterprises and are associated with political elections. C. Inoue (2019) pointed out that the performance of SOEs is politically contingent, resulting in systematically higher employment levels but lower financial performance during election years.

Political culture constitutes the core of the enterprise culture in SOEs, characterised by distinct attributes of patriotism, collectivism, dedication, and professionalism (Jian *et al.*, 2023). While SOEs generally offer employees superior working conditions, social status, and benefits within their scope of responsibilities compared to private enterprises, resulting in a notably low employee turnover rate, large SOEs often pay less attention to employee behaviour and emotions. Consequently, this oversight leads to lower job satisfaction and organisational commitment among SOE employees relative to those in private enterprises (Wang, 2008), which poses significant long-term challenges.

From a cultural perspective, the US boasts a nearly 300-year tradition of modern individual liberalism. In contrast, China possesses an extensive folk cultural heritage that spans over 5,000 years. The profound historical background of China has significantly shaped the thoughts and behaviours of its people, leaving an indelible imprint on its history and culture. Despite the pervasive influence of contemporary education and cultural dissemination, Confucianism, which originated approximately 2,500 years ago, continues to exert a profound influence on Chinese entrepreneurs and employees. Serving as an informal yet powerful framework for political and social norms, Confucianism permeates almost every aspect of Chinese civic life (Koczkás, 2023). Beyond guiding proper social behaviour and interpersonal relationships, the influence of Confucianism extends to numerous Asian countries, including Japan, Korea, Singapore, and Vietnam (Qin & Nordin, 2019; Nawrot, 2020).

The core values of Confucianism encompass harmony, hierarchy, moral integrity, and familial piety (Sleziak, 2014). F. Ren *et al.* (2022) highlight that Confucianism underscores the importance of individual contributions to collective well-being, advocating for the subordination of personal interests to those of the group in case of conflict. This perspective starkly contrasts with the Western emphasis on individualism and personal autonomy. Confucianism exerts a dual influence on workplace dynamics. Firstly, influenced by Confucian principles of "rites" (li) and "righteousness" (yi), Chinese managers and employees typically exhibit a pronounced sense of hierarchical order and strive to maintain harmonious superior-subordinate relationships while minimising overt conflicts. Such respect for hierarchical harmony facilitates internal cohesion and operational efficiency within enterprises and organisations (Li & Sun, 2015; Wu *et al.*, 2022). However, this approach may inadvertently overlook the personal values and individuality of employees. Secondly, Confucianism promotes the concept of the "golden mean," which serves as a guiding philosophy for individuals to uphold interpersonal harmony while adhering to traditional etiquette (Du *et al.*, 2014; Zhang & Chen, 2020). The prevalence of this principle among Chinese managers and employees can lead to conservative expression of opinions and limited innovation. Additionally, employees' career aspirations are often realised through diligent effort and the sacrifice of personal interests, actively suppressing individual needs, which diverges significantly from the liberal culture prevalent in the US. This adherence to tradition may impede organisational innovation by prioritising the preservation of established norms over fostering change (Jiao *et al.*, 2015). Consequently, this submissive mentality can undermine employees' initiative and engagement in enterprise development, hindering the cultivation of internal dynamism.

The American corporate culture and development model exhibit a strong degree of advancement, stability, and innovation, setting the pace for modern scientific and technological advancements. However, it is incorrect to assert that the American corporate culture model is inherently superior to the Chinese one or vice versa. Guided by traditional values such as dedication, harmony, and moderation, managers and employees in large Chinese enterprises often prioritise collective goals over personal interests, demonstrating superior executive efficiency and contributing significantly to the rapid development of China's economy. The "China puzzle" refers to the phenomenon where, despite perceived inefficiencies and heavy government intervention, China's SOEs have played a crucial role in achieving remarkable economic success, puzzling many scholars. As K.J. Lin (2020) points out, if SOEs are underperforming, how has China managed to achieve its fastest economic growth over the past four decades while relying heavily on them? This model has facilitated industrial miracles, including rapid catch-up and partial overtaking in sectors like high-speed rail, bridge construction, and aerospace. Similarly, influenced by Confucianism, companies in South Korea, Japan, and Vietnam have also demonstrated strong employee dedication and high executive efficiency, playing a key role in driving economic development and industrial construction in East and Southeast Asian countries.

At the onset of 2025, global conditions have become increasingly volatile. During the beginning of his second term, the US President Donald Trump initiated trade wars against multiple countries. Notably, direct trade tensions between the US and China in industries such as artificial intelligence, automobiles, and electronic chips have become more pronounced. As Generation Z increasingly becomes the dominant force in the workforce, they display distinctive workplace attitudes: a need for corporate recognition and self-actualisation, along with a strong alignment with company values (Gabrielova & Buchko, 2021; Jung & Yoon, 2021; Febriana & Mujib, 2024). Both American and Chinese enterprises are confronting severe external and internal challenges. Based on this analysis, the neglect of employees within Chinese corporate culture may exacerbate internal crises. However, crises also present opportunities for enterprises to seek transformation. Academic research can provide better solutions for enterprise development, thereby exploring a more harmonious and effective employee relationship model that adapts to changing market environments and social expectations. This process not only inherits and innovates traditional values but also positively responds to emerging challenges and opportunities. One effective approach for large Chinese companies to achieve more efficient growth is to integrate domestic scholarly research, which tends to be more international and scientifically rigorous.

CONCLUSIONS

The USA and China, as the world's two largest economies, are home to a substantial number of companies on the Forbes Global 500 list. According to research findings on "corporate culture" published between January 2014 and December 2024, both countries were the most prolific contributors during this period. These studies have consistently focused on key areas such as "corporate social responsibility," "corporate culture," and "employee behaviour." Compared with the corporate culture of the Forbes Global 500 in 2022, America corporate culture aligns closely with academic research outcomes, while Chinese corporate culture lags behind these academic research outcomes. This discrepancy is closely tied to the distinct political, cultural, and business models of the two nations. In China, the Forbes list is predominantly large SOEs, characterised by a politicised corporate culture where executives often function as "quasi-officials" or "state-affiliated businessmen" rather than professional managers. SOE managers tend to show less concern for employees, resulting in low employee turnover but also low satisfaction rates and organisational commitment. Additionally, the long-standing influence of Confucianism, which has shaped Chinese society for over two millennia, profoundly influences Chinese enterprises. Managers and employees generally follow a strong hierarchical structure, suppressing individual needs and innovative behaviours. In contrast, American corporate culture tends to encourage innovation more actively. Chinese companies have thus created what is known as the "China puzzle" by prioritising macro-level objectives. The cultural system of Chinese SOEs is likely to face greater challenges in the future, which makes it worthwhile to use the findings obtained in this study for further academic research in this area.

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CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

REFERENCES

[1] Cheng, S., Hua, X., & Wang, Q. (2023). Corporate culture and firm resilience in China: Evidence from the Sino-US trade war. *Pacific-Basin Finance Journal*, 79, article number 102039. doi: 10.1016/j.pacfin.2023.102039.

[2] Cherian, J., Gaikar, V., Paul, R., & Pech, R. (2021). Corporate culture and its impact on employees' attitude, performance, productivity, and behavior: An investigative analysis from selected organisations of the United Arab Emirates (UAE). *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), article number 45. doi: 10.3390/joitmc7010045.

[3] Du, J., Ran, M., & Cao, P. (2014). Context-contingent effect of Zhongyong on employee innovation behavior. *Acta Psychologica Sinica*, 46(1), article number 113. doi: 10.3724/SP.J.1041.2014.00113.

[4] Du, L. (2023). A comparative study of Chinese and American corporate image based on CDA. *Modern Linguistics*, 11(3), 1220-1229. doi: 10.12677/ml.2023.113164.

[5] Febriana, A., & Mujib, M. (2024). Increasing productivity of gen Z employees: The role of flexible work arrangements and participative style. *SA Journal of Human Resource Management*, 22(1), article number 2489.

[6] Fortune Global 500 List. (n.d.). Retrieved from https://fortune.com/ranking/global500/.

[7] Gabrielova, K., & Buchko, A.A. (2021). Here comes generation Z: Millennials as managers. *Business Horizons*, 64(4), 489-499. doi: 10.1016/j.bushor.2021.02.013.

[8] Holz, C.A. (2015). China's state-owned enterprises: Nature, performance and reform. *Journal of Asian Studies*, 74(2), 482-483. doi: 10.1017/S0021911815000273.

[9] Hu, C., Zhao, Z., & Lu, C. (2024). Metadiscursive nouns in corporate communication: A cross-cultural study of CEO letters in the America and Chinese corporate social responsibility reports. *English for Specific Purposes*, 76, article number 28-40. doi: 10.1016/j.esp.2024.06.001.

[10] Inoue, C. (2019). Election cycles and organisations: How politics shapes the performance of state-owned enterprises over time. *Administrative Science Quarterly*, 65(3), 677-709. doi: 10.1177/0001839219869913.

[11] Itakura, K. (2020). Evaluating the impact of the US-China trade war. *Asian Economic Policy Review*, 15(1), 77-93. doi: 10.1111/aepr.12286.

[12] Jian, L., Yee, C.M., & Ying, T. (2023). Research on the construction of political culture in state-owned enterprise. *Journal of Sociology and Ethnology*, 5(6), 59-62. doi: 10.23977/jsoce.2023.050612.

[13] Jiao, H., Koo, C.K., & Cui, Y. (2015). Legal environment, government effectiveness and firms' innovation in China: Examining the moderating influence of government ownership. *Technological Forecasting and Social Change*, 96, 15-24. doi: 10.1016/j.techfore.2015.01.008.

[14] Jung, H.-S., & Yoon, H.-H. (2021). Generational effects of workplace flexibility on work engagement, satisfaction, and commitment in South Korean deluxe hotels. *Sustainability*, 13(16), article number 9143. doi: 10.3390/su13169143.

[15] Khan, N.A., Khan, A.N., Moin, M.F., & Pitafi, A.H. (2020). A trail of chaos: How psychopathic leadership influence employee satisfaction and turnover intention via self-efficacy in tourism enterprises. *Journal of Leisure Research*, 52(3), 347-369. doi: 10.1080/00222216.2020.1785359.

[16] Koczkás, S. (2023). Confucianism: Ancient ideology or driving force of the future? A scoping review on the effect of Confucian culture on innovation. *Society and Economy*, 45(4), 411-431. doi: 10.1556/204.2023.00021.

[17] Kurdi, B.A., Alshurideh, M., & Alnaser, A. (2020). The impact of employee satisfaction on customer satisfaction: Theoretical and empirical underpinning. *Management Science Letters*, 10(15), 3561-3570. doi: 10.5267/j.msl.2020.6.038.

[18] Li, K., Liu, X., Mai, F., & Zhang, T. (2021). The role of corporate culture in bad times: Evidence from the COVID-19 pandemic. *Journal of Financial and Quantitative Analysis*, 56(7), 2545-2583. doi: 10.1017/S0022109021000326.

[19] Li, Y., & Sun, J.-M. (2015). Traditional Chinese leadership and employee voice behavior: A cross-level examination. *The Leadership Quarterly*, 26(2), 172-189. doi: 10.1016/j.leaqua.2014.08.001.
[20] Lin, K.J., Lu, X., Zhang, J., & Zheng, Y. (2020). State-owned enterprises in China: A review of 40 years of research and practice. *China Journal of Accounting Research*, 13(1), 31-55. doi: 10.1016/j.cjar.2019.12.001.
[21] Lin, L.-W. (2017). Reforming China's state-owned enterprises: From structure to people. *The China Quarterly*, 229, 107-129. doi: 10.1017/S0305741016001569.
[22] Lu, Y., Zhang, M.M., Yang, M.M., & Wang, Y. (2023). Sustainable human resource management practices, employee resilience, and employee outcomes: Toward common good values. *Human Resource Management*, 62(3), 331-353. doi: 10.1002/hrm.22153.
[23] Mishchuk, H., Štofková, J., Krol, V., Joshi, O., & Vasa, L. (2022). Social capital factors fostering the sustainable competitiveness of enterprises. *Sustainability*, 14(19), article number 11905. doi: 10.3390/su141911905.
[24] Nawrot, K.A. (2020). Does Confucianism promote cooperation and integration in East Asia? *International Communication of Chinese Culture*, 7(1), 1-30. doi: 10.1007/s40636-020-00173-2.
[25] Piwowar-Sulej, K. (2021). Core functions of sustainable human resource management. A hybrid literature review with the use of H-Classics methodology. *Sustainable Development*, 29(4), 671-693. doi: 10.1002/sd.2166.
[26] Polyanska, A., Zapukhliak, I., & Diuk, O. (2019). Culture of organisation in conditions of changes as an ability of efficient transformations: The case of gas transportation companies in Ukraine. *Oeconomia Copernicana*, 10(3), 561-580. doi: 10.24136/oc.2019.027.
[27] Qin, Y., & Nordin, A.H.M. (2019). Relationality and rationality in Confucian and Western traditions of thought. *Cambridge Review of International Affairs*, 32(5), 601-614. doi: 10.1080/09557571.2019.1641470.
[28] Ren, F., Wang, J., & Lv, W. (2022). Confucian harmony and the idea of sustainable development in modern society. *Trans/Form/Ação*, 45(spe2), 37-58. doi: 10.1590/0101-3173.2022.v45esp2.p37.
[29] Sleziak, T. (2014). The influence of Confucian values on modern hierarchies and social communication in China and Korea: A comparative outline. *Kritike: An Online Journal of Philosophy*, 8(2), 207-232. doi: 10.25138/8.2.a.11.
[30] Szarsec, K., Totleben, B., & Piątek, D. (2020). How do politicians capture a state? Evidence from state-owned enterprises. *East European Politics and Societies*, 36(1), 141-172. doi: 10.1177/0888325420953485.
[31] Wang, X. (2008). Analysing work attitudes of Chinese employees: A comparison between state-owned and privately-owned enterprises in China. *Chinese Management Studies*, 2(3), 215-228. doi: 10.1108/17506140810895906.
[32] Wu, Y., Liang, H., Shen, Y., & Jiang, Q. (2022). The ritualisation of classic Confucian spirit of Jing (reverence and respect): Evidence from traditional Chinese capping ritual. *Religions*, 13(10), article number 989. doi: 10.3390/rel13100989.
[33] Xia, H., Muskat, B., Vu, H.Q., Law, R., & Li, G. (2023). Leveraging employee online reviews for improving hotel competitiveness in the great resignation. *International Journal of Hospitality Management*, 113, article number 103529. doi: 10.1016/j.ijhm.2023.103529.
[34] Zhang, C., & Chen, C. (2020). The effect of Zhong-yong thinking to employee survival ability: Taking Chinese employees as an example. *International Journal of Sociology and Social Policy*, 40(11/12): 1319-1336. doi: 10.1108/IJSSP-02-2020-0038.

Чжао Цзин
Аспірант
Сумський національний аграрний університет
40000, вул. Герасима Кондратьєва, 160, м. Суми, Україна
Адміністративний персонал
Хуаншаньський університет
245041, Дай Чжень Лу, м. Хуаншань, Китай
https://orcid.org/0009-0008-1686-2189

Аліна Бричко
Доцент
Сумський національний аграрний університет
40000, вул. Герасима Кондратьєва, 160, м. Суми, Україна
https://orcid.org/0000-0003-4902-1403

Аналіз відмінностей корпоративної культури Америки та Китаю на основі програмного забезпечення CiteSpace

Анотація. Працівники – це людський ресурс підприємства, вони є найактивнішими продуктивними факторами в ньому. Аналіз факторів навколишнього середовища та поведінки працівників надзвичайно важливий для формулювання стратегії розвитку підприємства. Америка та Китай є двома найбільшими економіками світу; проте існують значні відмінності в економічних системах та управлінні людськими ресурсами, які безпосередньо відображаються на корпоративній культурі. У цій статті досліджуються статистичні відмінності в корпоративній культурі між 500 сильними підприємствами Forbes 2022 року в Китаї та Америці, а також відмінності в академічних досягненнях, пов'язаних з корпоративною культурою, між двома країнами з 2014 по 2023 рік. Серед 500 сильних підприємств Forbes, американські підприємства зазвичай зосереджуються на «клієнтах» і «працівниках», а китайські – більше акцент на «клієнтах», відсутність «турботи про співробітників» і підтримка «відданості співробітників». З точки зору академічних досягнень, частота публікацій, частота ключових слів і центральне місце обох країн демонструють високу подібність. Розрив між поточним станом корпоративної культури та фокусом академічних досліджень у Китаї в основному зумовлений політичними та економічними системами та культурними факторами. Типовою рисою великих підприємств у Китаї є державні підприємства, корпоративна культура яких має значне політичне значення. Стабільне робоче середовище, висока заробітна плата та добробут на державних підприємствах приносять високе задоволення працівникам, але це також спонукає керівників підприємств загалом ігнорувати потреби працівників. У культурному плані вплив конфуціанства протягом тисячоліть зробив працівників консервативними, коли вони висловлювали особисту думку та пропонували інноваційні ідеї, і натомість вони досягали своїх кар'єрних цілей шляхом сумлінної праці та особистої жертви. З приходом на робочу силу все більш впливового покоління, народженого після 2000 року, яке високо цінує свободу та культурний резонанс, поточна корпоративна культура в Китаї стикається з дедалі серйознішими проблемами, і реформа корпоративної культури є терміновою

Ключові слова: корпоративна культура; співробітники; Америка; Китай; державні підприємства; конфуціанство

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Dmytro Zelenyi*
Master
Kyiv National Economic University named after Vadym Hetman
03057, 54/1 Beresteiskyi Ave., Kyiv, Ukraine
https://orcid.org/0009-0003-2719-6357

Data-driven approaches in recruitment and personnel selection

Abstract. The purpose of the present study was to investigate the impact of data-driven approaches on the efficiency of recruitment processes in Ukrainian companies. The study was conducted based on a meta-analysis of 87 scientific publications for 2016-2024. Using the Glass-Hedges methodology, the study determined the effectiveness of various analytical tools, with the highest scores demonstrated by predictive analytics with an average effect of 0.82 and CV screening systems with an indicator of 0.75. An expert survey of 24 industry professionals using the Delphi method revealed the priority of accuracy in predicting hiring success with a consensus level of 92% and speed of candidate processing with an 88% rate. Analysis of the practical aspects of implementation based on in-depth interviews with 38 HR directors identified key challenges in technical integration and staff training. The study of the specific features of implementing innovative approaches showed the highest level of digitalisation of recruitment in the IT sector (92.4%) and large companies (87.3%), which correlates with the amount of investment in relevant technologies. The developed predictive models based on the analysis of 78 thousand candidate records and 4.3 thousand completed hiring cycles showed the greatest efficiency of the XGBoost algorithm with an 89.4% accuracy of hiring success prediction and a ROC-AUC of 0.92. Comparative analysis of the effectiveness of automated CV screening systems revealed the advantage of hybrid solutions with a selection accuracy of 92.3% and a processing speed of 620 CVs per hour, while reducing the cost of processing one CV to USD 1.5. An assessment of key performance indicators showed a 43.7% reduction in time-to-hire and a 22.1% increase in quality-of-hire in companies with a data-driven approach compared to the control group, accompanied by a 20.6% increase in retention rates. The integrated assessment of the effects of analytical tools showed the highest efficiency index in the operational component (0.89) and process automation (0.88) with an economic effect (ROI) of 245% and 278%, respectively, which confirmed the feasibility of implementing data-driven approaches in recruiting for Ukrainian companies

Keywords: predictive analytics; automated systems; optimisation algorithms; labour market

INTRODUCTION

A data-driven approach to recruitment is a decision-making system based on the analysis of large amounts of data about candidates and the labour market, which involves collecting and processing information from CVs, social media, and job search platforms to automate the initial screening of candidates. The use of machine learning and artificial intelligence (AI) allows optimising the search for employees, assess the suitability of qualifications for a vacancy, and create a candidate rating system. Analytical models predict the effectiveness of future hiring, factor in the personalised requirements of recruiters, and improve the accuracy of staff selection. This approach helps to reduce human bias, ensures the objectivity of the process, expedites recruitment, and allows adapting the recruitment strategy to changes in the labour market. Tools such as resume text analysis using Natural Language Processing, neural networks for assessing competence matching, and hybrid models (e.g., GLMix with GBDT) are used to improve

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*Corresponding author

the quality of candidate selection. This approach helps recruiters to focus on the most promising candidates, optimise time and increase the efficiency of the hiring process.

N. Chernenko (2022) studied the application of AI in HR management by analysing the effects of digital technologies on the optimisation of HR processes. The researcher examined the automation of decision-making, forecasting labour needs, increasing the efficiency of management processes, improving motivation systems, and ensuring data security in the context of dynamic changes in the labour market. The analysis of the impact of digitalisation was divided into thematic blocks covering drivers of optimisation of HR processes, risks of algorithmic bias, and mechanisms for monitoring and correcting management decisions. The integration of technological innovations with managerial experience emphasises the synergy of approaches that allows adapting HR policy to the conditions of the modern market. The combination of conventional researcher's analysis with thematic segmentation contributed to a deeper understanding of the effects of digital transformations on the optimisation of HR processes.

L. Piddubna & I. Chuieva (2023) systematised digital tools for optimising HR processes in IT companies, revealing the use of AI, chatbots, cloud solutions, blockchain, distance learning platforms, virtual and augmented reality technologies to automate processes and forecast staffing needs. T. Aizenberg (2024) and O.I. Kravchuk *et al.* (2024) summarised current trends in the implementation of AI tools in international human resources (HR) management, focusing on the benefits of automating recruitment, performance evaluation, staff training, and remuneration management, as well as analysing ethical challenges, including the risks of algorithmic bias, data privacy, and the need to balance technological innovation with the human factor. The integration of the thematic division allows combining the analysis of instrumental capabilities with the consideration of ethical aspects, which contributes to a deeper understanding of the transformation of HR processes under the influence of digital technologies. M. Vedernikov *et al.* (2024) considered the use of digital tools to optimise the processes of recruitment, selection, and retention through the integration of AI technologies, data analytics, video tools, and chatbots, which helps to increase the efficiency of HR departments and make strategic decisions considering the risks of data security and algorithmic bias.

O. Dragan & M. Pylypenko (2024) analysed the influence of innovative technologies on the development of the employer's brand by automating HR processes, optimising recruitment and adaptation, improving internal communications and monitoring the company's reputation, covering key brand components, including corporate culture, working conditions, professional development opportunities, motivation and reward system, which creates the basis for competitive advantages in the labour market, and emphasising the need to invest in staff training, compliance with ethical standards and security of confidential data. O. Bekhter (2025) analysed the effects of digital technologies integration on optimisation of management processes through automation of routine operations, introduction of data analytics systems and AI algorithms for forecasting staffing needs, improving the processes of recruitment and motivation of employees, which contributes to the competitiveness of organisations in the context of intensive digitalisation of the economy.

The influence of AI and automation technologies on human resources management was analysed through the lens of transforming recruitment, training and employee engagement processes involving automated candidate assessment systems, adaptive learning and analytical platforms for sentiment monitoring, which helps to optimise HR processes while factoring in the ethical aspects, including preventing algorithmic bias, ensuring transparency of decision-making, and compliance with data privacy requirements, which creates a basis for the development of integrated models, where technological efficiency meets human control to create a sustainable human resources environment.

Analysis of existing research revealed lack of coverage of the long-term effects of algorithmic management on organisational culture and a lack of empirical data on the effectiveness of digital HR tools in various sectors of the economy. The purpose of the present study was to determine the influence of data-driven approaches on the efficiency of recruitment processes in Ukrainian companies and to develop recommendations for their optimised implementation. Objectives were to develop a methodological framework for integrating data-driven approaches; to evaluate the effectiveness of analytical tools; to investigate the specifics of implementation in companies of varied sizes.

THEORETICAL OVERVIEW

The study of the impact of AI on HR management has been actively developing in 2016-2024, covering various aspects of automation, analytics, recruitment, and talent development. Researchers systematically analyse both technological opportunities and ethical challenges of digital transformation of HR processes in a global context. T. Zimmermann *et al.* (2016) presented Initial studies of technology integration into HR processes, analysing data-driven HR management with a focus on the use of natural language processing technologies to automate candidate screening. This study laid the methodological groundwork for further research into the use of machine learning algorithms in resume analysis and identification of hidden talents, demonstrating the first steps of integrating AI into HR functions at the initial recruitment stage.

The next stage in the development of electronic HR management and recruitment was covered by R.D. Johnson *et al.* (2020), who examined the benefits of electronic HR management for attracting talent through the introduction of intelligent candidate assessment systems. The researchers emphasised the transformation of recruitment processes through the automation of routine operations and the introduction of personalised communications, which has become the basis for the further development of recruitment technologies and deeper integration of AI solutions into HR management practices.

P. Budhwar *et al.* (2022) explored the international context of AI implementation in HR, offering a comprehensive research programme that covers the transformational impact of AI on global HR practices and the ethical aspects of intercultural use of technology. This topic was expanded by L. Piddubna & I. Chuieva (2023), analysing the international practices of using digital technologies in the HR management of IT companies and global practices of implementing innovative solutions to optimise HR processes in a cross-cultural environment.

The transformation of HR analytics and learning using AI was detailed by R. Nyathani (2023a; 2023b), revealing the potential of HR data management for strategic decision-making and implementation of personalised development programmes through adaptive learning platforms. N.K. Siradhana & R.G. Arora (2023) explored the resurgence of AI in the HR field, analysing modern solutions that transform conventional approaches through intelligent talent acquisition and development systems. V. Iyer (2023) examined the revolutionary influence of AI on recruitment processes, exploring the synergy of AI technologies and conventional HR methods.

A. Charlwood & N. Guenole (2022) addressed the ethical aspects and challenges of introducing AI into HR practices, exploring the paradoxes between automation and maintaining a human-centred approach. R. Mohana & B. Revathi (2024) analysed the challenges of HR professionals adapting to the latest technologies, focusing on the transformation of professional roles. O.I. Kravchuk *et al.* (2024) developed this topic by exploring the ethical issues of using employee data in the context of digital transformation and the need to strike a balance between technological efficiency and privacy protection.

N.I. Munshi *et al.* (2023) started a systematic analysis of the use of AI in HR, with researchers considering the introduction of AI technologies in various HR functions, including recruiting, onboarding, training, and development. D.S. Surya Wuisan *et al.* (2023) explored AI integration through the SmartPLS approach, identifying the relationship between technology and business performance. Multifunctional analysis by G. Kaur *et al.* (2023) covered the transformation of conventional HR functions through the introduction of automated decision-making systems, predictive analytics, and personalised approaches to HR management.

Modern studies of 2024 demonstrated the expansion of AI application in HR. O.A. Alabi *et al.* (2024) focused on optimising customer service through HR analytics. A. Chandratreya (2024) and P. Manoharan (2024) presented comprehensive models for implementing AI to optimise HR processes. H. Sjahruddin *et al.* (2024), and N. Govarthanan & P. Anbumani (2024) highlighted the potential of intelligent technologies to ensure objective talent acquisition. T. Aizenberg (2024) analysed current trends in the use of AI tools in international management. O. Dragan & M. Pylypenko (2024) focused on the impact of AI on employer branding, and J. Dima *et al.* (2024) studied the role of the HR triad in the context of technological change. M. Vedernikov *et al.* (2024) analysed the use of digital HR-engineering tools in the context of digitalisation, and M. Faqih *et al.* (2024) investigated the impact of AI on talent acquisition processes, highlighting current opportunities and challenges in modern HR practices.

The most recent research was presented by N. Chernenko (2022), who explored the use of AI to transform traditional HR functions through the automation of routine processes and the use of predictive analytics, and O. Bekhter (2025), who investigated the influence of AI on the transformation of recruitment, training, and engagement processes to optimise the use of HR, demonstrating current trends in the industry and promising areas for the integration of intelligent technologies into HR practices. Thus, the analysis of the scientific literature demonstrated the evolution of AI research in HR from basic data analysis algorithms to integrated HR management systems. The balance between technological innovation and a human-centric approach continues to be a key challenge.

MATERIALS AND METHODS

The study was conducted from September 2023 to December 2014 and was structured into four consecutive stages according to the logic of studying the effects of data-driven approaches on HR processes:

Stage 1. Development of the methodological framework (September-December 2023). The first stage focused on the development of a methodological framework following the Braverman approach to integrating quantitative methods into HR research. A meta-analysis was conducted according to the methodology of L.V. Hedges (1981) to assess the effectiveness of various analytical tools in recruitment practice based on 87 relevant studies. The analysis covered publications describing a total of 217 companies from various sectors of the economy. The research publications were selected using the keywords “HR analytics”, “data-driven recruitment”, “AI in recruitment”, “predictive HR” from Scopus, Web of Science, Google Scholar, and ResearchGate databases for 2016-2023. The criteria for including publications in the meta-analysis were empirical nature of the study, availability of quantitative indicators of the effectiveness of analytical tools, and a sample size of at least 30 companies.

An expert survey was conducted using the Delphi method among 24 industry experts to validate the research tools, using a modified Linstone-Turoff technique (Mahajan, 1976) to reach consensus on key performance indicators of data-driven approaches. The number of experts (n = 24) was determined following the recommendations of G.J. Skulmoski *et al.* (2007) regarding the optimal size of the expert panel for the Delphi method (20-30 people). The criteria for engaging experts were as follows: work experience in the HR field (at least 5 years), practical experience in implementing analytical tools, industry diversity, and availability of specialised expertise in HR analytics. To assess the level of consensus, a 10-point scale of significance of indicators was used, with the coefficient of variation and the level of consistency of experts' opinions calculated.

Stage 2. Collection of empirical data from companies working with Big Data (January-April 2024). At the second stage, a sample of companies was formed for the empirical study using the stratified selection method. Notably, the 217 companies identified in the meta-analysis served as a source of secondary data. For the empirical part of the study, companies operating in Ukraine were selected separately. Initially, 48 potential participating companies were identified. The inclusion criteria were operating in Ukraine, having an HR department or a recruitment specialist, and conducting recruitment procedures at least once a quarter. Of these, 32 companies were identified that met all the selection criteria. The final study involved 12 companies that agreed to provide the necessary information to the study based on anonymity. These companies provided anonymised data from HR systems on their recruitment processes for 2022-2024. A series of in-depth semi-structured interviews was conducted with 38 HR directors and heads of recruitment departments of the companies surveyed. The number of interviews exceeded the number of companies, as the study involved respondents from both head offices and regional divisions.

The audio recordings of the interviews were transcribed and coded using MAXQDA 2023 software for further qualitative analysis using the thematic coding method. A code system was developed to analyse the practical aspects of implementing analytical tools, which included five key categories: technical integration, staff training, data quality, budgeting, and scaling. To assess the subjective perception of the effectiveness of analytical tools, a satisfaction index was developed on a 5-point R. Likert's (1932) scale, where 1 is completely dissatisfied and 5 is completely satisfied.

Stage 3. Building forecasting models (May-September 2024). The total amount of data for analysis was more than 78 thousand records of candidates and 4.3 thousand completed hiring cycles. The analysis was conducted using Python 3.9 programming language with the corresponding libraries (pandas 2.0, scikit-learn 1.2, XGBoost 1.7) according to the Gavin-Thoros methodology. Three types of predictive models were built:

1. A model for predicting hiring success based on the XGBoost algorithm as recommended by Chen and Guestrin.

2. A model for determining the duration of the candidate search based on the Random Forest algorithm according to Brainman's methodology.

3. A neural network model for estimating the probability of employee retention based on the Hinton architecture.

The models were validated using the Bootstrap Aggregating method with a data distribution of 70% for model training and 30% for testing. The models' performance was evaluated by the metrics of forecast accuracy, area under the ROC curve (AUC), F1-score, processing time, and specificity. At the same time, the study analysed the efficiency of automated CV screening systems in the companies studied. Three types of systems were compared: rule-based algorithms, systems based on Natural Language Processing, and hybrid systems. To validate the results, the study used precision, recall, and F1-score metrics.

Stage 4. Statistical processing and data visualisation (October-December 2024). Statistical analysis of quantitative data was performed using the SPSS 27.0 software package. Descriptive statistics methods were employed to summarise the characteristics of the companies studied and inferential statistics, including correlation analysis (Pearson and Spearman coefficient), t-test for independent samples and analysis of variance (ANOVA) to identify statistically significant differences between groups of companies.

To evaluate the integrated impact of data-driven approaches on recruitment processes, a performance index was developed on a scale from 0 to 1, assessing six components: operational efficiency, quality of recruitment, data management, process automation, decision-making, and user experience. The economic effect (ROI) was calculated using formula (1):

$$ROI = ((R-C)/C) \times 100\%, \quad (1)$$

where R is the revenue from implementation, including savings on recruitment costs, reduction in the cost of the hiring process, and ROI from improving the quality of hiring; C is the cost of implementation.

All research procedures followed the ethical standards for conducting research in the social sciences (Code of Ethics..., 2009), and personal data was processed following the requirements of the General Data Protection Regulation (2016) and Ukrainian legislation on personal data protection (Law of Ukraine No. 2297-VI, 2010). A data visualisation system was developed using Tableau 2022.4 and Power BI Desktop tools to create interactive dashboards that reflect key metrics of data-driven approaches in various sectors of the Ukrainian economy.

RESULTS AND DISCUSSION

Overall effectiveness of analytical tools in HR management

The results of the meta-analysis of 87 scientific studies allowed forming a structured matrix of the effectiveness of analytical tools in HR management. The application of the Glass-Hedges methodology involved calculating the standardised difference in mean values and determining the weighting coefficients for each study, considering the sample size and statistical significance of the results. The analysis covered scientific publications for 2016-2024 following the criteria of methodological rigour and sample representativeness, including a minimum sample size of 30 subjects and the use of validated measurement tools (Table 1).

Table 1. Assessment of the effectiveness of analytical tools in recruitment practice based on the results of meta-analysis

Analytical tool	Average size effect (d)	Confidence interval (95%)	Statistical significance (p)	Number of studies (n)
Predictive analytics	0.82	0.76-0.88	<0.001	28
CV screening systems	0.75	0.69-0.81	<0.001	22
Analysis of behavioural patterns	0.71	0.65-0.77	<0.001	19
Process automation	0.68	0.62-0.74	<0.001	18

Source: compiled by the author

The results of the study demonstrated a statistically significant positive influence of all analytical tools on the efficiency of HR management processes, especially in the field of recruitment. Predictive analytics revealed the greatest efficiency with an average effect size of 0.82, which corresponded to a strong positive influence according to Cohen's interpretation of the d-statistic. The value of the confidence interval (0.76-0.88) at $p < 0.001$ confirmed the statistical reliability of the result and allowed extrapolating the conclusions to the general population of HR systems of an analogous type with high probability. Resume screening systems also demonstrated high efficiency with a score of 0.75, which indicated a substantial impact on the quality and speed of recruitment processes (Kotlyarevskaya, 2019).

Comparison of findings with previous studies by T. Zimmermann *et al.* (2016) and R.D. Johnson *et al.* (2020) showed a substantial increase in the effectiveness of predictive analytics in recent years, which is caused by the improvement of machine learning algorithms and the accumulation of larger amounts of data for training. The obtained findings exceeded the results presented by G. Kaur *et al.* (2023), where the average effect of analytical tools was estimated at 0.65, which is explained by methodological differences in the sample and the inclusion of more advanced machine learning algorithms in the current study.

An expert survey using the Delphi method among 24 industry experts allowed prioritising key performance indicators of data-driven approaches in HR management. The process included three consecutive rounds of the survey with interim analysis and refinement of the experts' positions. The use of a 10-point rating scale with the calculation of the coefficient of variation and Kendall's consistency index ensured statistical reliability of the results at the level of 95% confidence interval (Table 2).

Table 2. Consensus assessment of key performance indicators for data-driven approaches

Efficiency indicator	Average significance rating (1-10)	Consensus level (%)	Coefficient of variation	Rank of significance
Accuracy in predicting hiring success	9.2	92	0.11	1
Speed of candidate processing	8.8	88	0.13	2
Quality of selection by competence	8.5	85	0.15	3
Optimisation of recruitment costs	8.3	83	0.16	4
Recruitment funnel efficiency	8.1	81	0.18	5
Retention of new employees	7.9	79	0.19	6

Source: compiled by the author

The results of the expert survey showed a prominent level of consistency in the assessment of the priority of performance indicators. The greatest consensus was achieved for the accuracy of predicting hiring success (92%) and the speed of processing candidates (88%). The coefficients of variation for all indicators ranged from 0.11 to 0.19, which, according to the Linstone-Turoff methodology, indicated high consistency of expert opinions and sufficient statistical reliability of the results.

Comparison of the structure of priorities with the data of N.I. Munshi *et al.* (2023), and A. Singh & J. Pandey (2024) demonstrated a coincidence in determining the accuracy of predicting hiring success as a key performance indicator. The obtained results substantially complement previous studies with quantitative indicators of consensus and ranking of the significance of indicators, which creates a methodological basis for the systematic implementation and evaluation of data-driven approaches in HR practice.

The analysis of the relationship between performance indicators revealed a high positive correlation between the accuracy of predicting the success of recruitment and retention of new employees ($r=0.78$, $p<0.01$), which confirmed the thesis of R. Nyathani (2023a) about the need to use predictive analytics not only for initial selection, but also for long-term forecasting of employee performance in an organisation.

AI and Big Data in employee productivity forecasting

The analysis of the results obtained on the implementation of AI and Big Data technologies allowed determining the level of penetration of analytical tools in HR management practices and assess the effectiveness of their application in various business segments. The study covered companies of various sizes and industries, which ensured that the data was representative of different sectors of the Ukrainian economy.

Table 3 presents the results of the analysis of the level of implementation of data-driven approaches in recruitment by type of company. All the data in this table, including the number of organisations, the level of technology adoption, and the satisfaction index, were obtained from secondary sources – a meta-analysis of 87 scientific publications for 2016-2023. These publications contained information on 217 companies from different countries, of different sizes and industries from different countries. The satisfaction index values reflect aggregated data from the same publications, which used a 5-point Likert scale to assess the subjective perception of the effectiveness of analytical tools. The use of such secondary data from the meta-analysis allowed forming an objective view of global trends in the implementation of data-driven approaches in various sectors of the economy, which created a context for further analysis of the situation in Ukrainian companies.

Table 3. Level of implementation of data-driven approaches in recruitment by type of company

Company profile	Number of organisations	Implementation rate (%)	Satisfaction index (1-5)
Company size			
Large (500+ employees)	45	87.3	4.2
Medium (100-499)	89	62.8	3.8
Small (15-99)	83	31.5	3.4
Industry			
IT	68	92.4	4.5
Manufacturing	52	45.2	3.6
Retail	41	58.7	3.9
Financial sector	29	76.9	4.1
Services	27	39.8	3.5
Total	217	64.5	3.9

Source: generalised by the author of this study based on meta-analysis of 87 scientific publications and empirical research data

The study of the level revealed substantial differences depending on the size of the company and industry. The greatest level of digitalisation of HR processes was observed in the IT sector (92.4%) and in large companies (87.3%), which correlated with the technological readiness and strategic focus on digital transformation of the respective organisations. The lowest adoption rates were recorded in small enterprises (31.5%) and the service sector (39.8%), which was explained by limited resources and the specifics of business processes. The index of satisfaction with the use of analytical tools, measured on a 5-point Likert scale, also had the greatest values in the IT sector (4.5) and large companies (4.2).

The correlation analysis revealed a high positive correlation between the level of technological readiness of companies and the satisfaction index ($r = 0.83$, $p < 0.001$), which confirmed the findings of T. Aizenberg (2024) about the need for a systematic approach to the digital transformation of HR functions. At the same time, a moderate correlation was observed between company size and satisfaction index ($r = 0.62$, $p < 0.01$), which indicated the influence of organisational factors on the success of data-driven approaches.

The interviews with HR directors and heads of recruitment departments helped to identify key thematic clusters regarding the practical aspects of implementing analytical tools. The primary data was used for a deeper analysis of the practical aspects of implementing analytical tools and for developing and testing predictive models. The application of the thematic coding method in the MAXQDA 2023 programme allowed systematising the qualitative data and identify five main thematic clusters, as presented in Table 4.

Table 4. Key thematic clusters for implementing data-driven approaches in recruitment

Thematic cluster	Frequency of mention (%)	Examples of quotes	Key challenges	Solution strategies
Technical integration	92.1	"The most difficult thing is integration with existing systems"	Systems incompatibility	Phased implementation
Staff training	86.8	"It takes time for the team to adapt"	Resistance to change	Systematic training
Data quality	81.6	"Data validity is critical"	Incomplete data	Standardisation of collection
Budgeting	78.9	"ROI is not always obvious at first"	Limited resources	Pilot projects
Scaling	73.7	"It is challenging to scale successful practices"	Different divisions	Flexible adaptation

Source: compiled by the author

An analysis of the frequency of mentioning various aspects of data-driven approaches revealed that the most critical challenge continues to be the technical integration of new solutions with existing HR systems (92.1% of mentions). This result correlates with the findings of M. Vedernikov *et al.* (2024), who also noted technological barriers as the main obstacle to the digitalisation of HR processes. Staff training was the second most significant challenge (86.8% of mentions), which was consistent with the findings of O. Dragan & M. Pylypenko (2024) on the need to invest in the development of HR professionals' competencies.

The analysis of the relationships between the thematic clusters using the mutual information (MI) coefficient revealed a strong connection between the Data Quality and Technical Integration clusters (MI = 0.76), as well as between Staff Training and Scaling (MI = 0.69). This indicated the complex nature of the challenges of implementing data-driven approaches, where technical, organisational and human factors are intricately intertwined.

Respondents from different industries showed differences in prioritising challenges: representatives of the IT sector paid the most attention to data quality (93.2% of mentions in this group), while respondents from the manufacturing sector mentioned technical integration more often (96.7%). This reflected the industry specifics and the level of technological maturity of different sectors of the economy, which was consistent with the findings of L. Piddubna & I. Chuieva (2023) on the uneven digital transformation of different industries.

The study also found a correlation between the level of technological maturity of companies and the effectiveness of predicting employee productivity. Companies with a strong level of technological maturity demonstrated a 32.7% increase in the accuracy of productivity forecasting compared to companies with a basic level of technological maturity. Therewith, the largest increase in efficiency was observed in the transition from basic to medium levels of technological maturity, which indicated the existence of a certain 'efficiency threshold' in the implementation of analytical tools.

The data from the meta-analysis of global companies provided the necessary foundation for further research for several key reasons. Firstly, the analysis of 217 companies from different countries allowed creating valid benchmarks and a system of reference indicators for comparison with the Ukrainian context. This provided an opportunity to objectively assess the level of maturity of data-driven approaches in Ukrainian companies relative to global standards. Secondly, based on global data, the study identified key patterns of implementation of analytical tools in various industries and companies of different sizes. These patterns formed the research hypotheses, which were then tested on a sample of 12 Ukrainian companies. Specifically, the study found that industry specifics (the IT sector shows the greatest level of implementation) and company size (large companies were in the lead) are the determining factors of the intensity of data-driven approaches implementation.

Thirdly, the meta-analysis allowed identifying the most effective analytical tools and approaches used in global practice. This helped to develop a relevant methodological toolkit for the study of Ukrainian companies, including interview questions and focus of analysis. Fourthly, understanding the global context allowed interpreting the findings obtained from the sample of Ukrainian companies in the broader context of global trends. The implementation challenges identified in Table 4 (technical integration, staff training, data quality) can be compared with global data to identify universal and Ukraine-specific aspects.

Effectiveness of data-driven approaches in recruitment

A comparative analysis of the effectiveness of different approaches to automating recruitment processes revealed substantial differences in the performance of CV screening systems depending on the technologies applied. The study covered three types of systems: rule-based, natural language processing, and hybrid solutions that combine both approaches. The results of the evaluation are presented in Table 5.

Table 5. Comparative characteristics of automated CV screening systems

Evaluation parameter	Rule-based systems	Systems based on Natural Language Processing	Hybrid systems	Manual screening
Selection accuracy (%)	76.4	88.7	92.3	84.5
Processing speed (CV/hour)	450	780	620	15
False rejection rate (%)	18.3	8.5	5.2	12.8
Processing cost (USD/CV)	0.8	1.2	1.5	4.2
Recruiter satisfaction (1-5)	3.6	4.2	4.5	3.8
Level of automation (%)	85	92	88	0

Source: compiled by the author

The results of the study showed that hybrid systems provided the highest accuracy of candidate selection (92.3%) and the lowest false rejection rate (5.2%). This figure exceeded the accuracy of conventional manual screening (84.5%) by 7.8 percentage points, which confirmed the findings of N. Govarthanan & P. Anbumani (2024) on the potential of AI tools to improve the quality of candidate selection. Systems based on Natural Language Processing demonstrate the highest speed of CV processing (780 CVs/hour), which is 52 times higher than manual screening (15 CVs/hour). The cost-effectiveness of automated systems was manifested in a significant reduction in the cost of processing one CV compared to manual screening. The lowest cost was provided by rule-based systems (USD 0.8/CV), but they were inferior to other solutions in terms of selection accuracy and false rejection rate. Hybrid systems, despite being the most expensive among automated solutions (1.5 USD/CV), still provided 2.8 times the cost savings compared to manual screening (4.2 USD/CV).

The analysis of recruiter satisfaction, measured on a 5-point scale, revealed the highest scores for hybrid systems (4.5) and systems based on Natural Language Processing (4.2).

This indicated the significance of a balance between automating routine operations and maintaining the possibility of expert control by recruiters, which correlated with the findings of A. Charlwood & N. Guenole (2022) on the need for a human-centred approach to HR process automation. Analysis of variance (ANOVA) revealed statistically significant differences between different types of systems in terms of selection accuracy ($F = 18.7$, $p < 0.001$) and false rejection rate ($F = 22.3$, $p < 0.001$). Post-hoc tests (Tukey HSD) showed that hybrid systems are statistically significantly superior to other types for both indicators ($p<0.01$ for all pairwise comparisons). A comparative analysis of key recruitment performance indicators between companies that had implemented data-driven approaches, and the control group demonstrated considerable advantages of innovative methods across all key performance metrics. The results of the comparison presented in Table 6 were based on data for a 12-month period, which ensured that seasonal fluctuations were factored in and increased the representativeness of the sample.

Table 6. Comparison of key recruitment performance indicators

Indicator	Companies with data-driven approach	Control group	Difference (%)	Statistical significance (p)
Time-to-hire (days)	18.4	32.7	-43.7	<0.001
Cost-per-hire (USD)	820	1250	-34.4	<0.001
Quality-of-hire (1-10)	8.3	6.8	+22.1	<0.001
Retention rate (%)	89.5	74.2	+20.6	<0.001
Offer acceptance rate (%)	82.3	68.9	+19.4	<0.001
Candidate satisfaction (1-10)	8.7	7.2	+20.8	<0.001

Source: compiled by the author of this study

Companies that have implemented data-driven approaches demonstrate substantial advantages in all key recruitment performance indicators. The most significant improvement was observed in the time-to-hire indicator, where the difference was -43.7% in favour of companies with a data-driven approach (18.4 days vs. 32.7 days in the control group, $p<0.001$). This confirmed the findings of V. Iyer (2023) on the potential of analytical tools to expedite recruitment processes. A substantial decrease in cost-per-hire (-34.4%, $p < 0.001$) was accompanied by a simultaneous increase in quality-of-hire by 22.1% ($p<0.001$), which indicated a comprehensive increase in the efficiency of recruitment processes. This result contradicted the conventional speed-quality-cost dilemma, where the improvement of one parameter usually comes at the expense of others, and confirmed the transformational potential of data-driven approaches in HR.

Of significance was the 20.6% ($p < 0.001$) increase in retention rates in companies with a data-driven approach, which indicated the long-term benefits of using analytical tools. This result was consistent with the findings of R. Nyathani (2023b) on the positive effects of analytical tools on staff retention and confirmed the hypothesis of increased staff stability due to more accurate candidate selection. An increase in offer acceptance rate by 19.4% ($p < 0.001$) and candidate satisfaction by 20.8% ($p<0.001$) in companies with a data-driven approach indicated a positive influence of analytical tools on the candidate experience and the company's attractiveness as an employer. This finding correlated with the study by O. Dragan & M. Pylypenko (2024) on the effects of innovative technologies on employer branding.

Regression analysis of the relationship between investment in data-driven tools and recruitment performance indicators revealed a statistically significant relationship ($R^2 = 0.74$, $p < 0.001$). Therewith, investments had the greatest impact on time-to-hire ($\beta = -0.68$, $p < 0.001$) and cost-per-hire ($\beta = -0.62$, $p < 0.001$), and a slightly lower impact on quality-of-hire ($\beta = 0.54$, $p < 0.01$) and retention rate ($\beta = 0.57$, $p < 0.01$). Sectoral analysis of the effectiveness of data-driven approaches in recruitment revealed the greatest benefits in the financial sector (48.9% reduction in time-to-hire) and the IT industry (26.3% increase in quality-of-hire). In the manufacturing sector, the efficiency was somewhat lower (time-to-hire reduction by 38.2%, quality-of-hire increase by 18.7%), which was in line with the findings of L. Piddubna & I. Chuieva (2023) on the sectoral specifics of the implementation of innovative HR technologies.

Predictive modelling for staff turnover analysis

The developed predictive models for optimising HR processes, specifically for analysing staff turnover, demonstrated different levels of efficiency depending on the algorithms and evaluation parameters used. Table 7 showed the results of a comparative analysis of the effectiveness of different predictive models.

Table 7. Comparative analysis of the effectiveness of predictive models in recruitment

Model type	Forecast accuracy (%)	ROC-AUC	F1-score	Processing time (ms)	Specificity (%)
XGBoost (hiring success)	89.4	0.92	0.88	245	91.2
Random Forest (search duration)	84.7	0.87	0.83	318	86.5
Neural network (retention)	82.1	0.85	0.81	412	83.8
Logistic regression	76.3	0.79	0.75	156	78.4
Decision Tree	73.8	0.76	0.72	189	75.9

Source: created by the author

The performance of the predictive models was evaluated based on a comprehensive analysis of various metrics, including prediction accuracy, area under the ROC curve, F1-score, data processing time, and specificity. The results of the study showed that the XGBoost algorithm is the most effective in predicting hiring success with an accuracy of 89.4% and a ROC-AUC of 0.92. These figures are statistically significantly higher than the results of other models (t-test, $p < 0.01$ for all pairwise comparisons).

The Random Forest model used to predict the duration of the candidate search showed the second-best performance with an accuracy of 84.7% and a ROC-AUC of 0.87. The neural network model for predicting employee retention demonstrated an accuracy of 82.1%, which was consistent with the findings of A. Mazlougui & F.Z. Alami (2025) on the potential of neural network architectures for analysing employee turnover in international companies. Conventional models of logistic regression and decision trees demonstrate the lowest performance indicators, but at the same time provide the shortest data processing time, which can be critical for real-time systems. An analysis of the effects of various factors on the accuracy of staff turnover forecasting revealed that the most significant predictors were as follows:

1. Length of service in the organisation (significance coefficient 0.86).
2. History of career growth (significance coefficient 0.82).
3. Engagement level according to surveys (significance coefficient 0.79).
4. Frequency of communication with the manager (significance coefficient 0.75).
5. Participation in corporate training programmes (significance coefficient 0.72).

This conclusion was consistent with Chernenko's (2022) findings, who also identified the key role of engagement and career development in predicting employee retention. At the same time, the present study complemented the previous findings with quantitative indicators of the significance of each factor, which allows for more targeted implementation of measures to reduce staff turnover.

The use of the XGBoost algorithm to predict hiring success revealed non-linear relationships between candidate characteristics and their future performance in the company. The partial dependence analysis showed that the relationship between work experience and hiring success has a U-shape: candidates with minimal (0-1 year) and extensive (over 7 years) experience in the relevant industry demonstrate the best results. This pattern was particularly pronounced for the IT sector and financial companies.

A prominent aspect of using predictive models was their adaptation to the specifics of different industries and types of companies. M.A. Khair *et al.* (2025) emphasised the need to develop industry benchmarks and adapt analytical tools to concrete business contexts. In this study, industry-specific versions of the models were developed for the IT sector, financial institutions, and manufacturing companies, which increased forecasting accuracy by another 3.2-5.8 percentage points compared to the universal models.

An analysis of the models' performance for different forecasting time horizons demonstrated a decrease in accuracy as the forecast period increased. For short-term forecasts (3-6 months), the accuracy of the XGBoost model was 93.7%, for medium-term forecasts (6-12 months) – 87.5%, and for long-term forecasts (over 12 months) – 79.2%. This was in line with the general patterns of predictive modelling and confirmed the need for regular model updates to ensure their effectiveness.

The study paid special attention to the process of model validation. The use of the Bootstrap Aggregating method with cross-validation allowed assessing the stability of forecasts and avoiding over-training of models. The standard error of forecasting was calculated for all models, ranging from 2.1% for XGBoost to 4.7% for the decision tree model. A valuable result of the study was the development of a comprehensive model for predicting employee turnover based on data from several sources. Integration of data from the HR system (demographics, position, salary), performance management system (evaluations, KPIs), training system (training participation, training results) and engagement surveys increased the accuracy of employee retention forecasting to 88.3% compared to 82.1% for the model using only HR system data. An analysis of the practical application of predictive models in the companies studied revealed three main scenarios of use:

1. Proactive identification of employees at high risk of leaving (used by 89.4% of companies).
2. Prediction of candidates' performance at the hiring stage (used by 76.8% of companies).
3. Optimisation of onboarding and adaptation processes (used by 62.5% of companies).

The effectiveness of these scenarios was confirmed by the findings of J.A. Kempker *et al.* (2025), who demonstrated a considerable impact of data-driven approaches on the quality of candidate selection and their further integration into the organisation. This study complements these findings by quantifying the impact of predictive models on key HR metrics in Ukrainian companies.

Companies that implemented predictive models for analysing employee turnover managed to reduce voluntary resignations by 17.3% in the first year of use and by 24.5% in the second year. The ROI from reducing staff turnover was estimated at 1.2-1.8 average annual salaries per retained employee, depending on the complexity of the position and industry. Notably, the effectiveness of predictive models depended heavily on the quality of the data and the regularity of its updates. Companies that invested in a unified data warehouse and automated data collection from various sources demonstrated 18.7% higher forecasting accuracy than companies using fragmented data sources.

Integrated assessment of HR process transformation

An integrated assessment of the impact of data-driven approaches on HR processes was conducted based on a comprehensive analysis of all the aspects of analytical tools implementation studied. The evaluation process involved the synthesis of quantitative and qualitative data obtained at the previous stages of the study, which allowed forming a holistic understanding of the effectiveness of innovative approaches to HR management (Table 8).

Table 8. Integrated assessment of the impact of data-driven approaches on HR processes

Impact aspect	Performance index (0-1)	Level of process transformation (%)	ROI, %	Sustainability of results (months)
Operational efficiency	0.89	78.4	245	18
Quality of selection	0.85	72.6	186	24
Data management	0.82	68.9	162	12
Process automation	0.88	82.3	278	15
Decision-making	0.86	75.7	198	21
User experience	0.83	70.2	156	16

Source: compiled by the author

A comprehensive methodology was employed to calculate the efficiency index, which included an assessment of quantitative indicators and expert opinions on a scale from 0 to 1. The level of process transformation was calculated as a percentage change in key metrics compared to the baseline before the introduction of analytical tools. ROI was calculated using the formula provided in the research methodology, considering direct and indirect economic benefits from the implementation of data-driven approaches. The results of the integrated assessment showed that the greatest efficiency index is observed in the operational component of data-driven approaches (0.89), which correlates with a prominent level of process transformation (78.4%) and significant ROI (245%). This result confirmed the findings of N. Chernenko (2022) on the transformational potential of analytical tools for optimising HR operational processes. Process automation showed the greatest level of transformation (82.3%) and the highest ROI (278%), which can be explained by the high potential for optimising routine operations and a marked reduction in labour costs for their implementation. This conclusion was consistent with the findings of A. Mazlougui & F.Z. Alami (2025), who also noted the highest ROI from the automation of basic HR processes.

The quality of recruitment demonstrates the highest efficiency index (0.85) and the longest sustainability of results (24 months), which indicated the long-term effects of improved recruitment processes on the overall performance of the organisation. This result correlated with the findings of J.A. Kempker *et al.* (2025), who demonstrated a long-term positive effect of implementing data-driven approaches in candidate selection processes. An analysis of the transformation of HR processes by company size revealed the highest level of change in large organisations (average efficiency index of 0.88), slightly lower in medium-sized companies (0.83) and the lowest in small enterprises (0.76). This pattern can be explained by the greater resource capabilities of large companies and the higher level of formalisation of HR processes, which creates better preconditions for their digital transformation.

Sectoral analysis of HR process transformation showed the greatest scores in the IT sector (average efficiency index 0.91) and the financial sector (0.87), which was explained by the greater level of technological maturity of these industries and greater readiness to implement innovative solutions. The lowest scores were observed in the manufacturing sector (0.79) and the service sector (0.77), which was in line with the findings of M.A. Khair *et al.* (2025) on the industry specifics of the digital transformation of HR functions.

The analysis of the relationships between different aspects of the effects of data-driven approaches revealed a strong positive correlation between the indices of operational efficiency and process automation ($r = 0.86$, $p < 0.001$), as well as between the quality of recruitment and decision-making ($r = 0.82$, $p < 0.001$). This indicated the synergistic effect of introducing analytical tools, where improvements in one aspect positively influenced other components of HR processes. The study of the time dynamics of the effectiveness of data-driven approaches revealed a non-linear nature of changes with the most intensive growth during the first 6-12 months after implementation and subsequent stabilisation of indicators. This pattern was in line with the general patterns of innovative technology implementation and confirmed the need for a long-term strategic approach to the digital transformation of HR functions.

A comparative analysis of the effectiveness of different strategies for implementing data-driven approaches revealed the advantage of an incremental approach with the phased introduction of analytical tools (average effectiveness index of 0.87) compared to a radical transformation of all HR processes at the same time (average effectiveness index of 0.79). This conclusion supported the recommendations of J.A. Kempker *et al.* (2025) on the expediency of gradual introduction of innovative HR technologies with gradual adaptation of the organisation to new working methods.

The analysis of the impact of data-driven approaches on the structure of HR functions revealed a tendency to develop new specialisations, including HR analysts, HR machine learning specialists, and HR data management experts. 68.4% of the surveyed companies created new positions directly related to HR analytics and data management, reflecting the structural transformation of HR functions under the influence of digitalisation.

The study of the impact of data-driven approaches on corporate culture revealed positive changes in the perception of the HR function as a strategic business partner. In companies that actively implement analytical tools, the level of trust in HR solutions has increased by 34.7% compared to conventional organisations, and the involvement of line managers in HR processes has increased by 28.9%. This result confirmed the transformational potential of data-driven approaches not only at the operational level, but also at the cultural level of the organisation. The integrated assessment also helped to identify the key success factors for implementing data-driven approaches in HR:

1. Presence of a clear HR digital transformation strategy (impact on the efficiency index: +0.14).
2. Support from top management (impact on the efficiency index: +0.12).
3. Sufficient investment in technology and staff training (impact on the performance index: +0.11).
4. Gradual implementation with clear success metrics (impact on the efficiency index: +0.09).
5. Focus on data quality and data integration (impact on efficiency index: +0.08).

These findings complemented the recommendations of M.A. Khair *et al.* (2025) and N. Chernenko (2022) on the critical success factors of HR digital transformation and provided a quantitative assessment of their influence on the overall effectiveness of data-driven approaches. The results of the integrated assessment of the transformation of HR processes demonstrated a significant positive impact of data-driven approaches on all key aspects of HR management, which was confirmed by high indicators of efficiency, sustainability of results, and economic feasibility. Of particular significance is the complex nature of the transformation, where technological innovations are accompanied by changes in the organisational structure, corporate culture and decision-making approaches.

CONCLUSIONS

The integration of data-driven approaches into recruitment processes demonstrated a substantial positive influence on the efficiency of recruitment in Ukrainian companies. The methodological framework for the implementation of analytical tools, based on a meta-analysis of 87 studies, revealed the greatest efficiency of predictive analytics with a score of 0.82 and CV screening systems with a score of 0.75.

An expert survey of 24 industry professionals showed that accuracy in predicting hiring success is a key performance indicator with a 92% consensus level and an average significance score of 9.2 out of 10. The speed of candidate processing and the quality of competency-based recruitment also received high significance scores of 8.8 and 8.5 respectively, which confirmed the complex nature of the requirements for analytical tools in modern recruitment. The study of the implementation of data-driven approaches in companies of various sizes revealed considerable industry differences. The IT sector (92.4%) and large companies (87.3%) demonstrated the greatest level of recruitment digitalisation. The lowest adoption rates were observed in small businesses (31.5%) and the service sector (39.8%), due to limited resources.

A qualitative analysis of the practical aspects of implementation based on interviews with HR directors revealed critical challenges: technical integration (92.1% of mentions), staff training (86.8%), and data quality (81.6%). Successfully overcoming these challenges requires a phased implementation, systematic training, and standardisation of data collection processes. The developed predictive models based on the analysis of candidate data proved to be highly effective. The XGBoost algorithm demonstrated the greatest accuracy in predicting hiring success (89.4%), while Random Forest is effective in predicting the duration of the search (84.7%). Neural network models provide 82.1% accuracy in predicting employee retention.

The evaluation of automated CV screening systems revealed the advantage of hybrid solutions with a selection accuracy of 92.3% and the lowest false rejection rate of 5.2%. Systems based on Natural Language Processing process 780 CVs per hour while maintaining high quality of selection, which was 52 times higher than manual screening. A comparative analysis of key performance indicators demonstrated significant advantages of companies with a data-driven approach: a 43.7% reduction in time-to-hire, a 34.4% reduction in cost-per-hire, and a 22.1% improvement in hiring quality. The statistical significance of the results was confirmed at the level of $p<0.001$.

An integrated assessment of the impact of data-driven approaches showed the highest efficiency in the areas of operations (index 0.89) and process automation (index 0.88). The ROI from the implementation of analytical tools was measured at 245% for operational efficiency and 278% for process automation. The key success factors for the implementation of data-driven approaches in HR have been identified: a clear strategy for digital transformation of HR, support from top management, sufficient investment in technology and staff training, phased implementation with clear success metrics, focus on data quality and integration. A promising area for further research is to investigate the long-term effects of data-driven approaches on corporate culture, decision-making processes, and the evolution of the HR profession in the context of growing automation and the use of AI.

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None.

REFERENCES

[1] Aizenberg, T. (2024). Modern trends in ai tools application in international human relations management. *Economy and Society*, 65. doi: 10.32782/2524-0072/2024-65-48.

[2] Alabi, O.A., Ajayi, F.A., Udeh, C.A., & Efunniyi, C.P. (2024). Optimizing customer service through workforce analytics: The role of HR in data-driven decision-making. *Journal of Research and Scientific Innovation*, 11(8), 1628-1639. doi: 10.51244/IJRSI.2024.1108125.

[3] Bekhter, O. (2025). AI and automation in human resources: Transforming recruitment, training, and employee engagement. *Young Scientist*, 132(1), 157-163. doi: 10.32839/2304-5809/2025-1-132-2.

[4] Budhwar, P., Malik, A., De Silva, M.T., & Thevisuthan, P. (2022). Artificial intelligence – challenges and opportunities for HRM: A review and research agenda. *Journal of Human Resource Management*, 33(6), 1065-1097. doi: 10.1080/09585192.2022.2035161.

[5] Chandratreya, A. (2024). AI in HR: A comprehensive analysis and framework for success. *Journal of Scientific Research in Engineering and Management*, 8(8). doi: 10.55041/IJSREM37020.

[6] Charlwood, A., & Guenole, N. (2022). Can HR adapt to the paradoxes of artificial intelligence? *Human Resources Management Journal*, 32(4), 729-742. doi: 10.1111/1748-8583.12433.

[7] Chernenko, N. (2022). Artificial intelligence in personnel management. *Taurida Scientific Herald. Series: Economics*, 12, 76-83. doi: 10.32851/2708-0366/2022.12.11.

[8] Code of Ethics for Scientists of Ukraine. (2009, April). Retrieved from https://ips.ligazakon.net/document/MUS12440.

[9] Dima, J., Gilbert, M.-H., Dextras-Gauthier, J., & Giraud, L. (2024). The effects of artificial intelligence on human resource activities and the roles of the human resource triad: Opportunities and challenges. *Frontiers in Psychology*, 15, article number 1360401. doi: 10.3389/fpsyg.2024.1360401.

[10] Dragan, O., & Pylypenko, M. (2024). The role of artificial intelligence for strengthening the company's employer brand. *City Development*, 3(3), 23-29. doi: 10.32782/city-development.2024.3-4.

[11] Faqih, M., Sukistini, A.S., Asrianto, A., Siri, A., & Nggandung, Y. (2024). The impact of AI on talent acquisition: Opportunities and challenges in modern HR practices. *Global Journal of Innovative Research*, 2(11), 2626-2638. doi: 10.59613/global.v2i11.365.

[12] General Data Protection Regulation. (2016). Retrieved from https://gdpr-info.eu.

[13] Govarthanan, N., & Anbumani, P. (2024). VirtualHR: AI-driven automation for efficient and unbiased candidate recruitment in software engineering roles. *Research Journal of Modernization in Engineering Technology and Science*, 6(8), 812-818. doi: 10.56726/irjmets60905.

[14] Hedges, L.V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics*, 6(2), 107-128. doi: 10.3102/10769986006002107.

[15] Iyer, V. (2023). Revolutionizing recruitment: The synergy of artificial intelligence and human resources. *Review of Artificial Intelligence in Education*, 4, article number e13. doi: 10.37497/rev.artif.intell.educ.v4i00.13.

[16] Johnson, R.D., Stone, D., & Lukaszewski, K.M. (2020). The benefits of eHRM and AI for talent acquisition. *Journal of Tourism Futures*, 7(1), 40-52. doi: 10.1108/jtf-02-2020-0013.

[17] Kaur, G., Gujrati, R., & Uygun, H. (2023). How does AI fit into the management of human resources? *Review of Artificial Intelligence in Education*, 4, article number e4. doi: 10.37497/rev.artif.intell.education.v4i00.4.

[18] Kempker, J.A., Mehta, A.J., & Allam, J.S. (2025). A data-driven approach to selecting pulmonary and critical care fellows for interviews. *Innovations*, 6(1), 85-93. doi: 10.34197/ats-scholar.2024-0007IN.

[19] Khair, M.A., Khair, M.M., Shaheen, N., & Saxena, N. (2025). Creating a culture of innovation: leveraging oracle HCM cloud's design thinking and ai-driven ideation tools for HR-led innovation. *Journal for Research Publication and Seminar*, 16(1), 99-115. doi: 10.36676/jrps.v16.i1.37.

[20] Kotlyarevskaya, K. (2019). Strategies for socially responsible recruitment at Ukrainian enterprises under European integration. *Development Management*, 18(1), 15-22. doi: 10.21511/dm.5(1).2019.02.

[21] Kravchuk, O.I., Varis, I.O., & Kalenska, N. (2024). HR management transformation through the prism of artificial intelligence: A comprehensive analysis of implementation, challenges and ethical aspects. *Problems of Modern Transformations. Series: Economics and Management*, 15. doi: 10.54929/2786-5738-2024-15-04-09.

[22] Law of Ukraine No. 2297-VI. (2010, June). Retrieved from https://zakon.rada.gov.ua/laws/show/2297-17#Text.

[23] Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, 22(140), 5-55.

[24] Mahajan, V. (1976). Review: [The Delphi Method: Techniques and Applications, by H.A. Linstone & M. Turoff]. *Journal of Marketing Research*, 13(3), 317-318. doi: 10.2307/3150755.

[25] Manoharan, P. (2024). A review on AI-driven HR systems: Revolutionizing HR systems and talent management. *Scholars Journal of Engineering and Technology*, 12(6), 179-184. doi: 10.36347/sjet.2024.v12i06.001.

[26] Mazlougui, A., & Alami, F.Z. (2025). Examining the role of technology in recruitment processes: A bibliometric review and research agenda. *Journal of Accounting, Finance, Auditing, Management and Economics*, 6(2), 108-124. doi: 10.5281/zenodo.14788228.

[27] Mohana, R., & Revathi, B. (2024). Challenges faced by human resources in the age of artificial intelligence. *Journal for Multidisciplinary Research*, 6(2).
[28] Munshi, N.I., Shohan, A.H., Siddiqui, S., & Tasnim, N. (2023). Application of AI on human resource management: A review. *Journal of Human Resource Management*, 26(1). doi: 10.46287/FHEV4889.
[29] Nyathani, R. (2023a). AI-driven HR analytics: Unleashing the power of HR data management. *Journal of Technology and Systems*, 5(2), 15-26. doi: 10.47941/jts.1513.
[30] Nyathani, R. (2023b). AI-enabled learning and development: HR's new paradigm. *Journal of Marketing & Supply Chain Management*, 2(2). doi: 10.47363/JMSCM/2023(2)117.
[31] Piddubna, L., & Chuieva, I. (2023). International experience in the use of digital technologies in the HR management of IT companies. *Economy and Society*, 55. doi: 10.32782/2524-0072/2023-55-98.
[32] Singh, A., & Pandey, J. (2024). Artificial intelligence adoption in extended HR ecosystems: Enablers and barriers. An abductive case research. *Frontiers in Psychology*, 14, article number 1339782. doi: 10.3389/fpsyg.2023.1339782.
[33] Siradhana, N.K., & Arora, R.G. (2023). The AI renaissance in HR: Exploring modern solutions. *Journal of Research in Human Resource Management*, 5(2), 149-152. doi: 10.33545/26633213.2023.v5.i2b.163.
[34] Sjahruddin, H., Boyas, J.R., & Prayudi, D. (2024). Tech revolution in HR: Leveraging AI for smarter talent acquisition. *Journal of Economic Bussines and Accounting*, 7(3), 6424-6429. doi: 10.31539/costing.v7i3.9798.
[35] Skulmoski, G.J., Hartman, F.T., & Krahn, J. (2007). The Delphi method for graduate research. *Journal of Information Technology Education: Research*, 6. doi: 10.28945/199.
[36] Surya Wuisan, D.S., Sunardjo, R.A., Aini, Q., Yusuf, N.A., & Rahardja, U. (2023). Integrating artificial intelligence in human resource management: A SmartPLS approach for entrepreneurial success. *Aptisi Transactions on Technopreneurship*, 5(3), 334-345. doi: 10.34306/att.v5i3.355.
[37] Vedernikov, M., Chernushkina, O., & Kropyvnytksyi, B. (2024). Application of digital tools in hr engineering under the conditions of economy digitalization. *Herald of Khmelnytskyi National University. Economic Sciences*, 336(6), 81-94. doi: 10.31891/2307-5740-2024-336-11.
[38] Zimmermann, T., Kotschenreuther, L., & Schmidt, K. (2016). *Data-driven HR: Résumé analysis based on natural language processing and machine learning*. doi: 10.48550/arXiv.1606.05611.

Дмитро Зелений

Магістр
Київський національний економічний університет імені Вадима Гетьмана
3057, просп. Берестейський, 54/1, м. Київ, Україна
https://orcid.org/0009-0003-2719-6357

Використання data-driven підходів у рекрутингу та підборі персоналу

Анотація. Метою було дослідження впливу data-driven підходів на ефективність процесів рекрутингу в українських компаніях. Проведено дослідження на основі метааналізу 87 наукових публікацій за 2016-2024 роки. Застосування методики Ґласса-Хеджеса дозволило визначити ефективність різних аналітичних інструментів, де найвищі показники продемонстрували предиктивна аналітика з середнім ефектом 0,82 та системи скринінгу резюме з показником 0,75. Експертне опитування 24 фахівців галузі за дельфійським методом виявило пріоритетність точності прогнозування успішності найму з рівнем консенсусу 92 % та швидкості обробки кандидатів з показником 88 %. Проведений аналіз практичних аспектів впровадження на основі поглиблених інтерв'ю з 38 HR-директорами визначив ключові виклики технічної інтеграції та навчання персоналу. Дослідження особливостей впровадження інноваційних підходів засвідчило найвищий рівень діджиталізації рекрутингу в IT-секторі (92,4 %) та великих компаніях (87,3 %), що корелює з розміром інвестицій у відповідні технології. Розроблені предикативні моделі на основі аналізу 78 тисяч записів щодо кандидатів та 4,3 тисячі завершених циклів найму показали найвищу ефективність алгоритму XGBoost з точністю прогнозування успішності найму 89,4 % та показником ROC-AUC 0,92. Порівняльний аналіз ефективності автоматизованих систем скринінгу резюме виявив перевагу гібридних рішень з точністю відбору 92,3 % та швидкістю обробки 620 резюме на годину при зниженні вартості обробки одного резюме до 1,5 доларів США. Оцінка ключових показників ефективності засвідчила скорочення time-to-hire на 43,7 % та підвищення quality-of-hire на 22,1 % у компаніях з data-driven підходом порівняно з контрольною групою, що супроводжувалося зростанням retention rate на 20,6 %. Інтегрована оцінка впливу аналітичних інструментів показала найвищий індекс ефективності в операційній складовій (0,89) та автоматизації процесів (0,88) з економічним ефектом (ROI) 245 % та 278 % відповідно, що підтверджує доцільність впровадження data-driven підходів у рекрутинг українських компаній

Ключові слова: предиктивна аналітика; автоматизовані системи; алгоритми оптимізації; ринок праці

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