PRACTICAL COMPONENT OF PROJECT IMPLEMENTATION OF INITIATIVES TO INCREASE THE DIGITAL COMPETITIVENESS OF THE ECONOMY

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Abstract. A country's digital competitiveness is regarded as its ability to promote the creation and implementation of modern digital technologies in the socio-economic, political, legal, and business life of members of society, leading to profound changes in state institutions, business models, and society as a whole. *The purpose of scientific research* is to characterize the priority areas of activity of countries in strengthening digital transformation and increasing digital competitiveness, as well as to outline effective ways to potentially increase the level of digital competitiveness of countries around the world. *Methodology.* The study was conducted on the basis of various methods, including: dialectical – to compare the scientific views of researchers on the importance of digital competitiveness of countries for their economic development and identify factors for its strengthening; systemic – to assess practical solutions, tools, and results of increasing the level of digital competitiveness of countries; graphical – to visually present the dynamics of changes in the overall rating of digital competitiveness of individual countries of the world as a whole and in terms of individual factors of influence; methods of analysis and synthesis – to review successful projects of the Program EU "Digital Europe" and the characteristics of "High Impact Projects" that stimulate the digital transformation of EU countries; comparison and generalization – to identify obstacles to the creation and implementation of innovations in Europe, and to develop practical measures to increase the digital competitiveness of countries. *Result.* The current Program EU "Digital Europe" for 2021–2027 was characterized, and it was found that modern technical and technological changes affect various

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spheres of life of members of society (education, medicine, production, trade, etc.) and become the driving forces of digital changes in the economy. Given the opportunities and challenges that arise during the creation, dissemination, and implementation of digital technologies in various spheres of socio-economic life of society, the work compares scientific approaches to understanding the category of "digital competitiveness". Based on the IMD World Digital Competitiveness Ranking 2023 data, a comprehensive analysis of the dynamics of changes in the digital competitiveness rating of individual countries of the world (TOP-10) was conducted in 2021–2023, both in general and in terms of factors influencing it, which made it possible to identify growth points and drivers for the future strengthening of competitiveness in the digital era. *Practical implications.* The paper summarizes practical steps, effective tools, and expected consequences of digital transformation, which is currently crucial for the economic stability and prosperity of countries. Factor analysis of the digital competitiveness rating showed that it directly depends, firstly, on technologies, and therefore it is necessary to strengthen the technological independence and identity of countries, strengthen their technological framework, and secondly, on the readiness of countries for the digital future – the ability to adapt, build digital infrastructure, and strengthen IT integration. *Value/originality* consists in visualizing the categorical apparatus associated with the digital competitiveness of countries, which expands the understanding of the drivers of ensuring such competitiveness in the context of globalization and innovation, outlines the state of development of the digital economy in individual countries of the world, and indicates the areas of socio-economic life of members of society that are undergoing changes under the influence of technical and technological transformations.

1. Introduction

Digital competitiveness today is not just a set of indices and indicators that allow comparing the economies of different countries of the world in terms of their openness, innovation, digitalization, sustainability, and inclusiveness. It is the unique ability of an economy to promote the creation and implementation of advanced digital technologies in various spheres of human life, which, one way or another, leads to a deep transformation in state institutions, business models, and society as a whole. Digitalization

is of great importance for individuals and representatives of business, the state, and, importantly, its impacts go far beyond the exclusively economic dimension but are manifested in the political, social, educational, cultural, medical, and other spheres of human life.

The goal of our study is to: characterize the state and priority areas of activity of European countries in strengthening digital transformation and increasing digital competitiveness; to clarify the economic changes in the concept of "digital competitiveness" and to investigate the dynamics of changes in the digital competitiveness rating of individual countries of the world (TOP-10) according to the IMD World Digital Competitiveness Ranking 2023, both in general and in terms of the factors "Technology" and "Readiness for the future"; to outline effective ways to potentially increase the level of digital competitiveness of countries of the world.

To achieve the goal of the scientific work, a reliable database was taken as a basis. A special place here belongs to theoretical and empirical studies published in scientific works in journals indexed in the scientometric databases Scopus and WoS, which are known for the high quality of scientific works. This approach to processing the materials available in the scientific literature is able to provide our study with representative and relevant data presented in scientific articles in various fields of knowledge and based on comprehensively described concepts and proven hypotheses on strengthening the digital competitiveness of countries, taking into account technological changes and innovative solutions of today.

The scientific article uses the following methods: dialectical – when considering the diversity of researchers' views on the importance of countries' digital competitiveness for their economic prosperity and identifying the factors that strengthen it; systemic – when reviewing practical solutions, tools, and results of increasing the level of countries' digital competitiveness; graphical – when visualizing the dynamics of changes in the rating of countries' digital competitiveness as a whole and in terms of individual influencing factors; methods of analysis and synthesis – when describing successful projects of the EU Program "Digital Europe" and "High Impact Projects", which are drivers of digital changes in EU countries; comparison and generalization – when identifying threats to the creation and use of innovative solutions and developments, and forming a set of measures to increase the digital competitiveness of countries.

2. Literature review

The issue of finding drivers of economic growth and the well-being of a nation in the era of digitalization and rapid transformations is more than ever in the focus of researchers from different countries. Of particular interest is the digital competitiveness of countries and the assessment of the driving forces behind its increase.

A team of researchers from the Czech Republic and Austria (M. Kuncova, K. Berkova, D. Frendlovska, R. Fureder, M. Uberwimmer, and B. Haas) note that digital competitiveness is important in terms of the ability to quickly respond to changing conditions, which was demonstrated by the Covid-19 pandemic. Therefore, they conducted an in-depth assessment of the level of digital competitiveness and the factors influencing it, using the example of two of their countries – the Czech Republic and Austria, in order to understand their ability to adopt and implement digital technologies in business and government organizations [17, p. 1].

Researchers from Slovakia D. Kiselakova, B. Sofrankova, M. Gombar, and M. Matijova indicate that the level of digital competitiveness of countries is influenced by two key indices – the Global Innovation Index (GII) and the Systemic Immune Inflammation Index (SII), and the driving forces of innovation efficiency and a strong competitive position in the market are research systems, innovative technologies and human resources, which are the basis of the digital transformation strategies of EU countries [11, p. 308].

M. Khazaei, M. Faghihi, and V. Manesh discuss the importance of digital competitiveness indicators for business efficiency and profitability. They study the impact of the digital competitiveness index on the financial performance of the world's leading companies using efficiency theory and assessing the reliability of the IMD digital competitiveness index data. The results obtained by the scientists showed that there is a positive relationship between the IMD digital competitiveness index and the financial performance of leading companies in the world [10, p. 29].

In continuation of this, researchers J. Stankovic, I. Marjanovic, S. Drezgic, and Z. Popovic conduct an assessment of digital competitiveness and rank European countries according to it in terms of three groups of indicators and their corresponding factors: 1) use of ICT in households and individuals (Internet use, Internet connection and computer use, e-government,

e-commerce (online shopping in the last 3 months), use of ICT at work); 2) use of ICT in enterprises (websites and use of social networks, e-business, e-commerce (enterprises with sales via e-commerce), Internet connection (enterprises with Internet access), ICT security (security measures used); digital skills (ICT users, ICT specialists in employment, ICT training) [28, p. 125].

Valuable, in our opinion, in the context of acquiring new digital knowledge and skills and increasing the level of digital literacy of members of modern society, are the scientific products of the international grant project "Teaching digital entrepreneurship" with the participation of scientific representatives from such European countries as Spain, Italy, Austria, Poland, and Ukraine. The researchers' work outlines the state and trends of digital transformations in various sectors of the economy in the context of individual countries, and also provides valuable advice on the accelerated implementation of digital tools in the lives of citizens and practical solutions for both business representatives and government bodies [1; 19; 8].

Representatives of the scientific community of European countries mainly focus their attention on the digital competitiveness of their countries. In particular, the Spaniards L. Marti, and R. Puertas analyze the competitiveness of EU countries "by creating a synthetic indicator that includes factors related to innovation (measured by the Global Innovation Index), digitalization (based on the digital economy) and the society index" in order to understand the ability of European countries to build the "Digital Decade"" [21, p. 1]. At the same time, researchers L. Cernanova, and F. Stovicek also note the growing role of digital technologies in the everyday life of society and seek to establish differences in the pace and trends of digitalization in different countries using the example of the Visegrad Four countries (Czech Republic, Poland, Slovakia, Hungary) and Denmark, taking into account the level of their digital competitiveness. To implement their study, the scientists used the IMD index, which describes the digital competitiveness of a country according to three factors – knowledge, technology, and readiness for the future [3, p. 32].

Researchers from Greece, E. Laitsou, A. Kargas, and D. Varoutas, provide an understanding of digital competitiveness through the lens of the effectiveness of the digital economy, which is an issue of national strategies

for achieving economic growth and socio-economic development. In their work, the scientists focus on the analysis of the Digital Economy and Society Index (DESI index) of Greece along five dimensions (connectivity, human capital, use of Internet services, integration of digital technologies, and digital public services), which allowed both to assess the current state of the country's economy and to forecast potential economic growth. The results obtained show that Greece has problems due to the low level of digitization, both on the demand side (enterprises consuming Internet services) and on the supply side (institutional and state restrictions) [18].

An attempt to assess the gap between the EU and the US in digital competitiveness based on the ICT Development Index (IDI) and the Overseas Digital Competitiveness Index (ODCI) was made by researcher I. Mlynarzewska-Borowiec. Her findings showed that "the gap in digital competitiveness between the EU and the US is increasing every year, especially in terms of ICT patent activity, the impact of ICT on new business and organizational models, the intensity of high-tech trade and the importance of the ICT sector in creating added value" [23, p. 364]. In order to achieve better results in terms of the level of digital competitiveness of European countries, V. Grosu, I. Andrioaia, and I.-M. Tiganas recommend also taking into account the level of economic development of the country, the degree of digitization, fiscal and environmental policies, which will allow developing a policy and strategy to promote sustainable and digital economic development in the region [7, p. 66].

Researcher I. Martincevic notes that "globalization and internationalization create new opportunities and challenges for companies' activities in the market. Through globalization, we are witnessing new trends and technologies, where digital transformation is radically affecting and changing the way organizations work. Digital transformation of business is inevitable and is an element of its further development… Achieving and ensuring long-term competitiveness is impossible today without digital technologies that create the prerequisites for its achievement" [22, p. 541].

Not only the work of European scientists is important in scientific research on the digital competitiveness of countries; in our opinion, a significant contribution to the study of the issue of the digital competitiveness of countries and their economic sustainability was made by F. Santoso,

P. Samputra, and E. Daryanto, because in addition to highlighting the features of the implementation of digital technologies, they emphasized the importance of a country's ability to effectively adjust its economic structure and policy within the framework of digital technologies. This approach expands the understanding of how progress in digital technologies ensures a country's resilience to economic shocks, and also emphasizes the need to adapt to the external world and introduce innovation in order to "formulate a balanced strategic policy that uses digital transformation for sustainable economic growth, effectively addressing today's global economic dynamics" [27, p. 1537].

We also made scientific attempts to study the nature of digital transformation and identify its impact on the country's economy [16], to understand the practical significance of advanced digital technologies in the socio-economic life of society [15], to analyze the existing experience of scientific and technological clustering in the world in the digital age [13], and to identify the connection between the level of innovation of the country's economy and social inequality as a result of the digital divide [14] between individual regions of the world.

3. Digital initiatives of the transformation of European countries

In 2021, the Ministry of Digital Transformation of Ukraine, together with the Office for Entrepreneurship and Export Development and GIZ, presented and launched the EU Programme "Digital Europe", which aimed to overcome the socio-economic consequences of the Covid-19 pandemic and ensure the rapid digital transformation of the countries of the European continent. The EU Programme "Digital Europe" for 2021–2027 "is aimed at supporting and developing advanced digital technologies in various sectors, creating the prerequisites for sustainable economic growth and improving the quality of life of people" [29].

After the full-scale invasion of Ukraine in February 2022, the EU Programme "Digital Europe" took on a new meaning, and therefore, in September 2022, Ukraine signed the Agreement on Participation in the EU Programme "Digital Europe" (2021–2027) [30]. Such a partnership is strategic for Ukraine, as it "opens up new horizons for Ukrainian innovations and provides access to resources and knowledge that can significantly change the country's digital landscape. For Ukraine, this means the possibility of

integration into the European digital space, the introduction of the latest technologies, and the development of digital infrastructure" [29].

It is noted that strengthening the EU's digital transformation is possible if a number of effective projects are implemented. The main ones are presented in Figure 1.

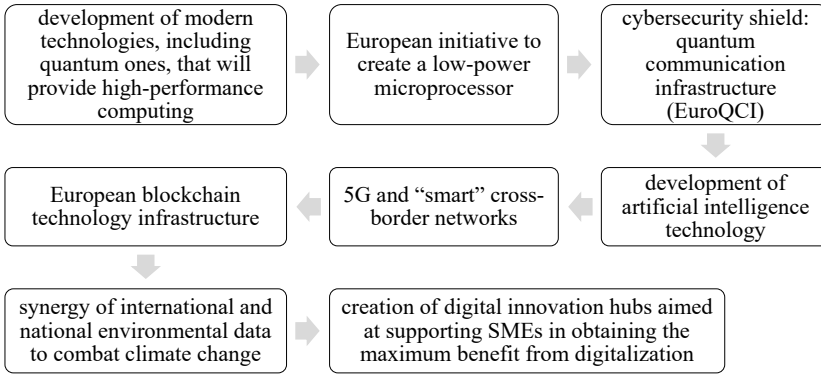

Figure 1. "High-impact projects" stimulating the digital transformation of EU countries within the framework of the implementation of the EU Programme "Digital Europe" (2021–2027)

Source: compiled based on the source [6]

Modern technical and technological changes and digital innovations affect all spheres of human life (education, medicine, leisure, transport, fashion, production, trade, agriculture, etc.) and become drivers of digital transformation and economic development. The initiatives of the EU Programme "Digital Europe" for 2021–2027 create new opportunities for expanding digital knowledge and skills, implementing digital tools in the activities of business entities, developing a digital ecosystem and innovation infrastructure, and improving the accessibility and quality of digital services for people. During the existence of the Programme, there are many successful practices in various spheres of life and activity of members of modern society (Table 1).

Table 1

Successful projects of the EU Programme "Digital Europe" (2021–2027), their achievements and areas of impact

Project	Project essence/goal	Financing	Coverage/performers	Achievements/Expectations
1	2	3	4	5
European Digital Media Observatory (EDMO)	Interdisciplinary Network on Countering Disinformation. *The goal:* to combat online disinformation that threatens democracy in the EU.	30 million EUR	14 national and multinational centers: managed by a consortium led by the European University Institute in Florence (Italy).	Contributed to the fight against disinformation campaigns during Covid-19, the war in Ukraine and the Palestinian-Israeli conflict. EDMO works to identify and warn the public about disinformation campaigns aimed at influencing EU elections.
EU Digital Identity Wallet Pilots	Personal digital wallet. *The goal:* to create a single and secure digital identity system that will allow EU citizens to safely and conveniently identify themselves in the online environment.	46 million EUR	2 lead countries (France, Germany) and 18 partner countries (Austria, Belgium, Cyprus, Czech Republic, Luxembourg, Estonia, Finland, Greece, Hungary, Italy, Latvia, Netherlands, Slovenia, Poland, Spain, Portugal, Slovakia, Ukraine).	Facilitates information exchange within the EU country and between other member states. The project is testing 6 options for using the tool: e-government services, opening a bank account, registering SIM cards, mobile driving licenses, qualified e-signature, e-prescription.
FAMES Pilot Line	Innovative technology to improve the performance of e-device batteries. *The goal:* to create a fully automated production line for the production of micro- and nanoelectronic systems.	1,6 billion EUR	Leading companies and research institutes in the field of micro- and nanoelectronics.	Products from the FAMES pilot line will provide applications, ICT enhancements using 5G/6G chips, and IoT development using advanced sensors and AI peripheral chips.

1	2	3	4	5
stinE: Building a Digital Twin of the Earth	Digital model. *The goal:* development of high-precision digital twins of the Earth for modeling and monitoring of natural phenomena.	300 million EUR	European Space Agency (ESA), European Centre for Medium-Range Weather Forecasts (ECMWF), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT).	The Digital Earth Model will revolutionize the modeling and monitoring of natural phenomena, hazards, and related human activities.
EUCAIM: Cancer Imaging and AI	Biomedical Imaging Project. *The goal:* To deploy a pan-European digital infrastructure for digital imaging of cancer cells.	30 million EUR	76 partners in 14 countries (Belgium, Italy, Czech Republic, Spain, Germany, Netherlands, Greece, France, Cyprus, Austria, Poland, Portugal, Finland, Sweden).	EUCAIM contains a catalogue of cancer imaging datasets. Access can be requested in accordance with applicable ethics and data protection regulations.
JUPITER: The First European Exascale Supercomputer	European Exascale Supercomputer. *The goal:* to create a supercomputer capable of performing calculations with exascale performance.	250 million EUR	After testing, JUPITER will be available to the scientific community, industry and the public sector.	JUPITER will feature high-performance, energy-efficient processors, including the first prototypes of "made in the EU" processors.
CyberSecPro	Educational Project. *The goal:* To train IT professionals to overcome current and future cybersecurity challenges.	6,7 million EUR	15 higher education institutions and 13 security companies.	The project bridges the gap between science and industry, transforming theoretical knowledge into practical skills.
AgrifoodTEF: AI Testing and Experimentation Facilities	Agricultural Project. *The goal:* to create testbeds for the implementation of AI in the agricultural and food industry.	30 million EUR	34 partners from 9 countries (Italy, France, Germany, Netherlands, Belgium, Poland, Sweden, Austria, Spain).	The project provides an opportunity for agribusiness to test new technologies in real conditions, ensuring the creation of specialized test environments.

Source: compiled based on the source [29]

The competitions, projects and initiatives of the EU Programme "Digital Europe" (2021–2027) are evidence not only that the European community follows digital transformations and stimulates scientific and technological progress and innovative development, but also creates the prerequisites for the formation of a digital order in the world and a new digital landscape in Europe, which change the philosophy of human existence, the perception of modern reality and human behavior, their attitude to work and leisure, and their ideas about business, society and the state.

Initiatives in Ukraine are not limited to educational or informational events; there are already successful practical solutions in the field of digital transformation. The first Ukrainian digital innovation hub "CLOTEX-HUB" has been created in Khmelnytskyi region, which has joined the network of European Digital Innovation Hubs and has an investment budget for 2025–2028 of 1.5 million EUR. The goal of CLOTEX-HUB is to increase the level of business efficiency in the garment industry and machine building industry through the active implementation of digital solutions and technologies (augmented and virtual reality, AI, cybersecurity, laboratories for testing innovations, advanced training of employees, in particular in digital literacy, etc.) [4].

Thus, the EU Programme "Digital Europe" for 2021–2027, which Ukraine has also joined, is currently a significant and reliable source of funding for projects and competitions focused on digitalization and innovation initiatives. The Programme is focused on creating opportunities for providers of various technological services to test digital solutions based on AI; equipping educational, medical and urban institutions with modern technologies and creating a powerful network with European digital innovation hubs; increasing the digital competitiveness of EU countries; developing an interoperable data sharing environment, etc.

4. Scientific understanding of the essence and significance of digital competitiveness

The prepared and presented report "The IMD World Digital Competitiveness Ranking. How does your country rank?" by researchers A. Bris, Ch. Cabolis, and J. Caballero provides an understanding of the nature of competitiveness, which is constantly changing in today's dynamically changing conditions, affecting both enterprises and countries as a whole.

The aforementioned document notes that "IMD World Competitiveness Center recognized the principle of developing a new analytical framework for assessing the state of digital affairs and further understanding competitiveness. It created the IMD World Digital Competitiveness Ranking, which is more targeted and assesses the capabilities and readiness of economies to begin the process of digital transformation" [2].

In general, scientific approaches to identifying the nature and essence of digital competitiveness are quite diverse today. We have highlighted some of them (Figure 2) to deepen our understanding of this economic category.

Digital competitiveness in the context of digital transformation means the effective use of digital technologies, processes and strategies to improve market position, stimulate innovation and increase overall productivity. Digital competitiveness encompasses the alignment of digital capabilities with objectives, flexibility in responding to changing market demands *(Lark Editorial Team)*.

- **Digital competitiveness** is a component of digital innovation capability and digital transformation maturity, where digital innovation capability includes experience, skills, training programs, and networks for developing new digital solutions *(A. Ko, A. Mitev, T. Kovacs, P. Feher, Z. Szabo)*.

Digital competitiveness is the ability of an economy to adopt and explore digital technologies, leading to transformation in government practices, business models, and society as a whole *(A. Bris, Ch. Cabolis, J. Caballero)*.

- **Digital competitiveness** is determined by digital innovation and the improvement of society's digital skills *(I. Mlynarzewska-Borowiec)*.

Digital competitiveness is a multidimensional framework that encompasses various factors of the digital transformation process through the ability to learn and apply new technologies, technological factors that enable digital transformation, and digital readiness factors that assess the readiness of the economy and citizens for digital transformation *(J. Stankovic, I. Marjanovic, S. Drezgic, Z. Popovic)*.

Figure 2. Modern approaches to the scientific understanding of the economic definition of "digital competitiveness" from the point of view of leading specialized organizations and researchers in the world

Source: compiled based on sources [5; 12, p. 80; 2; 23, p. 365; 28, p. 117]

The digital competitiveness of a country directly depends on the competitive positions of its leading companies in the global market. Using the example of companies, researchers A. Ko, A. Mitev, T. Kovacs, P. Feher

and Z. Szabo note that working "in a digitally turbulent environment, they are ready to experiment with digital technologies and implement financially risky projects… Companies that encourage change are ready to take greater risks. Digital flexibility, the ability to change and the willingness to take risks have a positive impact on the ability of companies to digitally innovate and the maturity of digital transformation. Flexible companies have stronger opportunities to implement digital innovations, develop internal capabilities or find partners to develop digital solutions... The effects between digital flexibility and digital competitiveness are significant and positive" [12, p. 90]. Such findings are valuable from a scientific point of view, as they emphasize the relevance of the issue of increasing the digital competitiveness and innovativeness of countries, especially given the instability of the external environment in recent times, geopolitical changes and geoeconomic fluctuations, the importance of digital innovations for the economy and society, as well as the need to acquire the ability to digital flexibility and adaptability.

Recently, a close direct relationship has been increasingly evident between the indicators of digital competitiveness of countries around the world and their economic status – the stronger the country is economically, the higher its level of digital competitiveness, and vice versa. And although the socio-economic consequences of the Covid-19 pandemic and geopolitical turbulence in the world have had an impact on the overall level of digital competitiveness (DC) of countries, the situation on a planetary scale has remained approximately the same, as evidenced by the data presented in Figure 3 for 2021–2023.

If we consider the digital competitiveness ranking of countries by region, then East Asia continues to be the leader, while North America and Western Europe are catching up. It is East Asian countries that significantly outperform all digital factors studied by IMD, in particular in terms of technology and readiness for the future. In recent years, both Western European countries and North American countries have demonstrated quite similar results in the digital competitiveness ranking.

The leadership of the United States in terms of digital competitiveness in 2021–2023 and strong competitive positions in terms of the pace of digital change in the Netherlands, Singapore, Denmark and Switzerland are notable (Figure 3). The positions of Hong Kong SAR and Sweden in the

2023 ranking have weakened somewhat compared to 2021, but this has not reduced their overall attractiveness as countries with innovative, open and steadily growing economies. Growth in digital competitiveness indicators in 2021–2023 is noticeable in the Republic of Korea (6th position in the 2023 ranking), Finland (8th position) and Taiwan, China (9th position), which indicates the comprehensiveness and consistency of state policy to support the creation and implementation of digital technologies in all areas of the economy and social life.

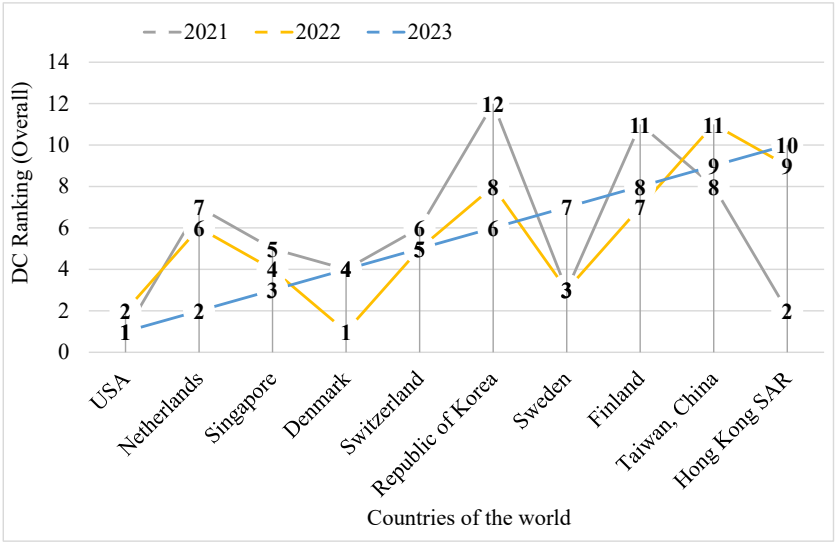

Figure 3. Dynamics of changes in the overall ranking of digital competitiveness of the countries of the world (TOP-10) according to the IMD World Digital Competitiveness Ranking 2023 in 2021–2023

Source: constructed based on the source [32, p. 38]

In the 2024 research report "Strengthening EU digital competitiveness: stoking the engine", scientists J. Marcus, and M. Rossi expressed concern about the decline in the competitiveness of EU countries in the world compared to other major economies. It is noted that European countries

have significant innovation potential and digital capabilities, but there are still no world-class players on the European continent that could compete on an equal footing with global leaders – the USA and China [20].

D. Kiselakova, B. Sofrankova, M. Gombar, and M. Matijova assessed the innovation and digital competitiveness of the EU-27 countries and showed how innovation performance affects the change in digital competitiveness. "Sweden and Finland, the two economies with the highest digital competitiveness ratings, had the best average innovation performance in 2017–2021. Nordic countries such as Sweden, Finland and Denmark, together with the Netherlands, are among the leaders in the assessment of innovation performance as well as digital competitiveness" [11, p. 307].

The stable development of European countries in the direction of digitalization and innovation, despite the Covid-19 pandemic, is also noted in their study by Spaniards L. Marti, and R. Puertas. "However, there is a significant digital and innovation gap between North-Central and South-Eastern Europe. Poland, Greece, Bulgaria and Romania occupy the last positions, as these are countries that face major financial barriers and obstacles related to human capital... European governments must commit to promoting economic policies that strengthen wealth, employment and research, as well as increasing funding for infrastructure investment [21, p. 8].

Romanian researchers G. Hurduzeu, I. Lupu, R. Lupu, and R. Filip found that the DESI index is significantly affected by exports of goods and skilled labor in both Central and Eastern European countries and Western European countries; in Central and Eastern European countries, the overall talent index (global talent), tax evasion and legislation are significantly and positively affected by DESI, while in Western European countries, GDP and digital transformation of companies have a positive impact on digital competitiveness; the connectivity index is significant for competitiveness in Central and European countries with eight significant positive impacts (skilled labor, exports of goods, pension provision, equal opportunities, image abroad, digital transformation of companies, science and research legislation, healthcare infrastructure), while Western countries have only six impacts (overall talent, GDP, GDP per capita, exports of goods, government budget surplus/deficit, disposable income) [9].

There are many stakeholders in assessing the state and ensuring the sustainable growth of digital competitiveness. These are customers, employees, co-owners, suppliers and partners, because they are all affected by digital opportunities and digital change strategies [5]. The practical success and outcome of digital transformation is significant and is manifested in a number of aspects that are decisive for stability and prosperity in the current environment (Figure 4).

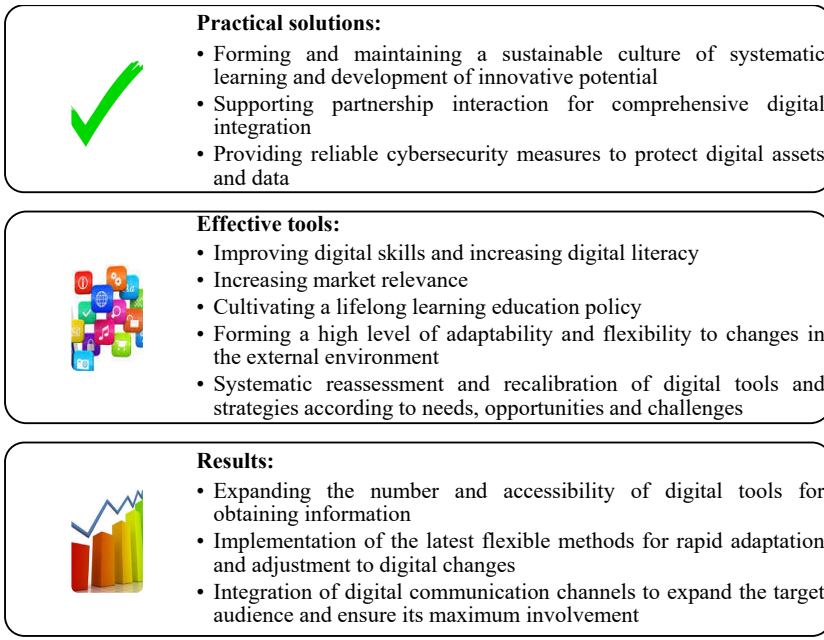

Figure 4. Practical solutions, tools and results of increasing the level of digital competitiveness of countries

Source: summarized based on the source [5]

5. Analysis of the dynamics of changes in the digital competitiveness ratings of countries in terms of influencing factors

The role of advanced technologies in the speed of digital transformation and ensuring the well-being of the nation in the current conditions is difficult

to overestimate, so it is not surprising that one of the key components by which the overall rating of digital competitiveness is compiled is technology (Figure 5).

According to the "Technology" factor of digital competitiveness in 2021–2023, the leaders are the same ten countries of the world as in the overall rating, which confirms the importance of technological developments, inventions and solutions for the formation of sustainable competitive advantages in the international arena. The best in the technological aspect in 2023 were countries such as Singapore, Hong Kong SAR and Taiwan China.

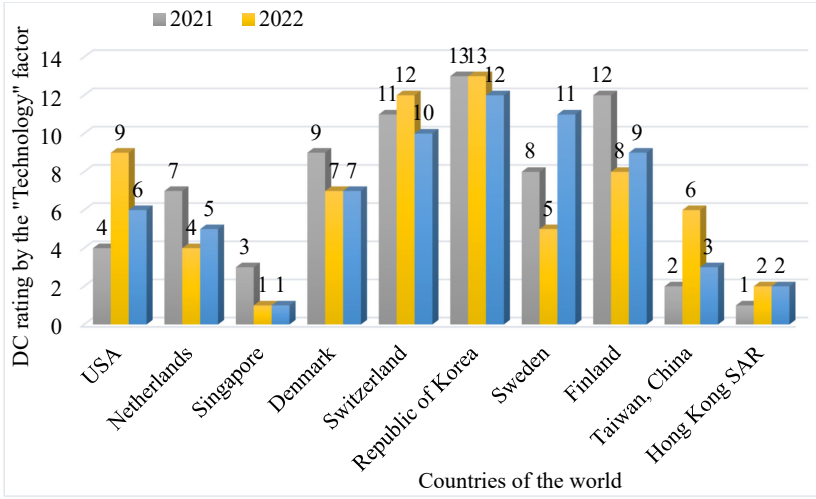

Figure 5. Dynamics of changes in the digital competitiveness rating of individual countries of the world (TOP-10) by the "Technology" factor according to the IMD World Digital Competitiveness Ranking 2023 in 2021–2023

Source: constructed based on the source [32, pp. 50–51]

The "Technology" factor of digital competitiveness in the report "The IMD World Digital Competitiveness Ranking. How does your country rank?" by A. Bris, Ch. Cabolis, and J. Caballero "assesses the

overall context through which the development of digital technologies is possible and includes the supporting regulatory framework that allows for effective business conduct and compliance with relevant regulations, while encouraging business development and innovation" [2].

According to the "Technology" factor of the digital competitiveness ranking, three subfactors are distinguished that are worth attention (Figure 6). The "Regulatory Framework" subfactor has the best performance indicators in 2023 in Singapore, the Netherlands and Finland. The "Capital" subfactor is represented by slightly different leaders in 2023 – the USA (1st position), the Netherlands (2nd position), Indonesia (3rd position). And finally, the "Technological Framework" subfactor is represented by the best positions of the following countries: Hong Kong SAR, Singapore, UAE. The above gives grounds to assert that technical and technological changes and scientific and technological progress in the country are possible only if an institutional environment with a perfect and clear regulatory framework is created and maintained at the proper level by the state; if the sphere of technology creation and dissemination has a sufficient level of funding and is open to attracting investments; if young and creative innovators, inventors who create these technologies are motivated and supported in every way; if an innovative ecosystem is formed and a digital infrastructure is developed that creates the architecture for technological changes.

Scientist S. Sahi notes that "as a result of the use of digital technologies and the subsequent digital transformation, the digital economy can become a driving force for economic development... The digital economy can establish itself as a sector that contributes to the expansion and development of economic subsystems... The digital economy scale index measures its size, and a high score indicates that the percentage of the digital economy in a particular country is likely to increase... The impact of the digital economy on the country is reduced if its scale is minimal. The digital economy cannot support the economic growth of the country if the country's economy is expanding" [26, p. 65].

Among the factors of digital competitiveness, "Future Readiness" is highlighted. In the document "The IMD World Digital Competitiveness Ranking. How does your country rank?" by researchers A. Bris, Ch. Cabolis, and J. Caballero, it is stated that this factor "tests the level of readiness of the economy for digital transformation, because competitiveness requires that

available digital technologies be "absorbed" by society. And the assimilation of digital technologies requires a special adaptive attitude, including the desire of society to participate in digital processes... Readiness assesses how well IT practices and processes are applied by all participants" [2].

The dynamics of changes in the "Future Readiness" factor of digital competitiveness in 2021–2023 is presented in Figure 7.

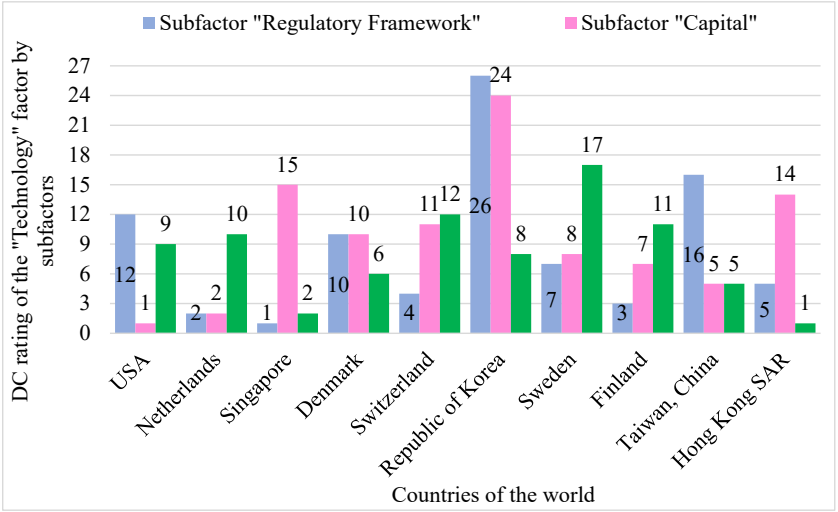

Figure 6. Digital competitiveness ranking of individual countries of the world (TOP-10) of the "Technology" factor in terms of subfactors according to the IMD World Digital Competitiveness Ranking in 2023

Source: constructed based on the source [32, pp. 57–179]

Of the TOP-10 countries according to the IMD World Digital Competitiveness Ranking 2023 in the ranking of the best in terms of digital competitiveness, all, with the exception of Hong Kong SAR, confirmed their leadership in this factor. Stable high positions in the ranking for the mentioned factor in 2021–2023 remained for the USA, the Netherlands, Denmark and the Republic of Korea.

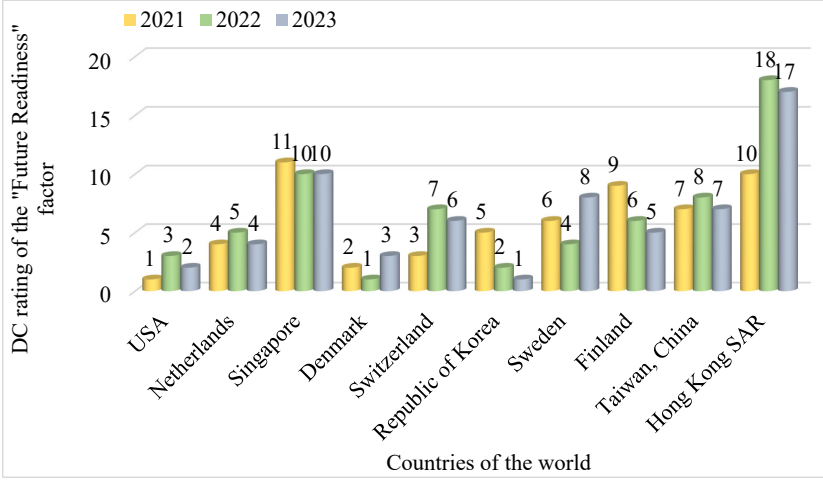

Figure 7. Dynamics of changes in digital competitiveness rating of the countries of the world (TOP-10) by "Future Readiness" factor according to the IMD World Digital Competitiveness Ranking 2023 in 2021–2023

Source: constructed based on the source [32, pp. 50–51]

The readiness of countries for the digital future is assessed in terms of three subfactors (Figure 8). In 2023, the leadership in the subfactor "Adaptive attitudes" belongs to the Republic of Korea, the USA and Finland. The subfactor "Business agility" is represented by the following leaders: Taiwan (China), the USA and the Republic of Korea. And in the subfactor "IT integration" in 2023, Israel became 1st in the ranking, Denmark 2nd and Finland 3rd. It is extremely important to ensure the country's competitive advantage as a whole in "Future Readiness" in the overall digital competitiveness index to make maximum efforts in all areas of its manifestation, because in the example of Hong Kong SAR, a close interaction of indicators is noticeable – only 47th place in the rating for "IT Integration", 16th place in "Business Agility" and 5th place in "Adaptive Settings" allowed the country to take 17th place in the digital competitiveness rating for the "Future Readiness" factor in 2023.

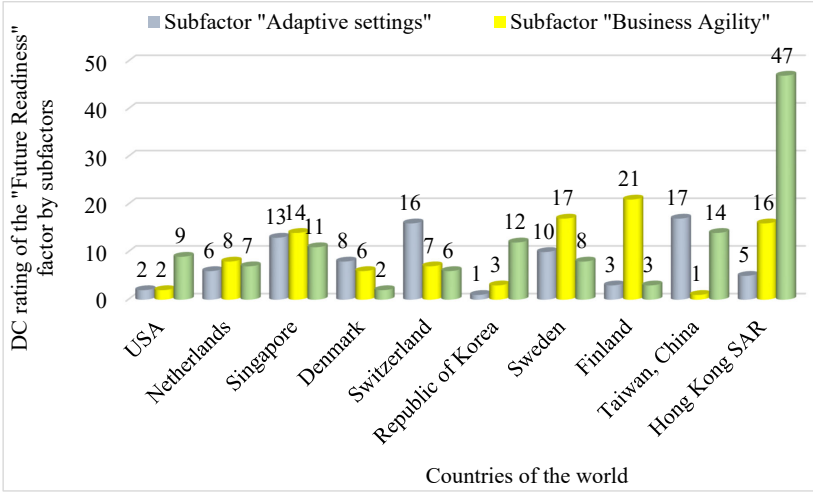

Figure 8. Digital competitiveness ranking of the countries of the world (TOP-10) by "Future Readiness" factor in terms of subfactors according to the IMD World Digital Competitiveness Ranking in 2023

Source: constructed based on the source [32, pp. 57–179]

The work of a researcher D. Sagarik, is devoted to the study of the role of digital government, digital competitiveness and readiness for the future, where he attempted to assess the digital economy according to several indicators of digital competitiveness and to identify how the implementation of digital variables in its context in countries contributes to the development of readiness for the digital future. Unlike his European colleagues, D. Sagarik takes as a basis data from 12 countries of the Asia-Pacific region [25, p. 1]. The results of the study showed: the importance of open government practices and cybersecurity in the digital era; the need to improve citizens' access to public information, to encourage participation in improving the quality of public services; the importance of the role of modern management in building trust in the digital economy; the lack of proper state support is an obstacle to the development and implementation of innovations; the importance of using digital technologies in the public sector for effective service delivery [25, p. 10].

6. Practical steps to achieve a high level of digital competitiveness of countries around the world

The report "The future of European competitiveness" European Commission in 2024 notes that the previous global paradigm is fading and the era of rapid growth of world trade is passing, and European companies are experiencing increasing competition from abroad and less access to foreign markets. Technical and technological changes are increasingly visible in the world, and Europe remains somewhat aloof from the digital revolution caused by the Internet. Therefore, it is not surprising that the lag of EU countries from the USA is most noticeable in the technology sector, only 4 of the 50 largest technology companies in the world are European. The digital transformation, decarbonization of the European economy and strengthening its defense capabilities in the current conditions require significant financing and investment. Only in this case will European countries be able to compete on the global stage in terms of labor productivity, development and implementation of advanced technologies, innovation, the level of climate responsibility, inclusion, accessibility and social security and integration [31, p. 1]. Europe still faces many obstacles on this path (Figure 9).

Valuable from a practical point of view are the recommendations provided by L. Cernanova, and F. Stovícek, which they proposed for the countries of Visegrad Four, taking into account their state of digital competitiveness (Figure 10). These tips can also be used by other countries that feel the need to strengthen their position in the world market in the digital era.

Ukraine has its own path in the process of increasing the level of digital competitiveness. Taking the experience of other countries as a basis would be a mistake, because it is more expedient to simply study it and implement only those practices and solutions that can really bring socio-economic benefits to our country. For example, in 2024, the OECD published the document "Enhancing Resilience by Accelerating the Digital Transformation of Business in Ukraine", which proposed "policy options for the future to build an ecosystem conducive to the digitalization of SMEs at the national and subnational levels; developing comprehensive services to support the digitalization of SMEs; introducing measures to help companies harness the potential of digital tools to solve complex issues related to the war, increase their resilience and overcome economic shocks" [24, p. 3].

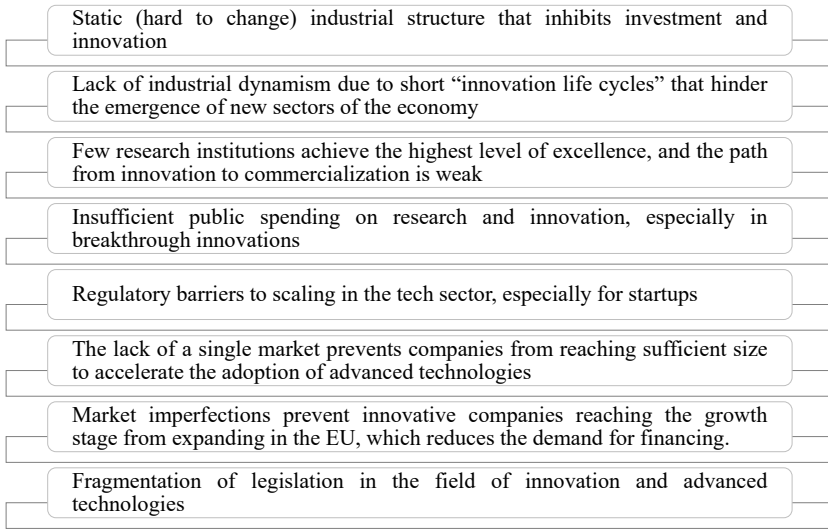

Figure 9. Key obstacles to the creation, diffusion and implementation of innovations in Europe

Source: summarized based on the source [31, pp. 24–28]

To increase Ukraine's digital competitiveness in the international arena and promote its economic recovery, the country's government is implementing a number of digital transformation steps. An attempt has been made to build an effective ecosystem for SME digitalization at the national and subnational levels, which has been reflected in thematic documents and strategies, such as the National Economic Strategy for the period up to 2030, the Global Innovation Vision of Ukraine 2030. In addition, a set of services has been developed to support the digitalization of SMEs, which often lack sufficient financial resources to invest in digital technologies, and therefore the Enterprise and Export Promotion Office (EEPO) provides them with specific online support services through "Diia". There is also the use of digital technologies to overcome the difficulties associated with the war and plan for the country's recovery, in particular in the context of stimulating the development of e-commerce as a way to mitigate the impact of trade disruptions and strengthening digital security as a tool for risk management and promoting overall cyber resilience [24, p. 14].

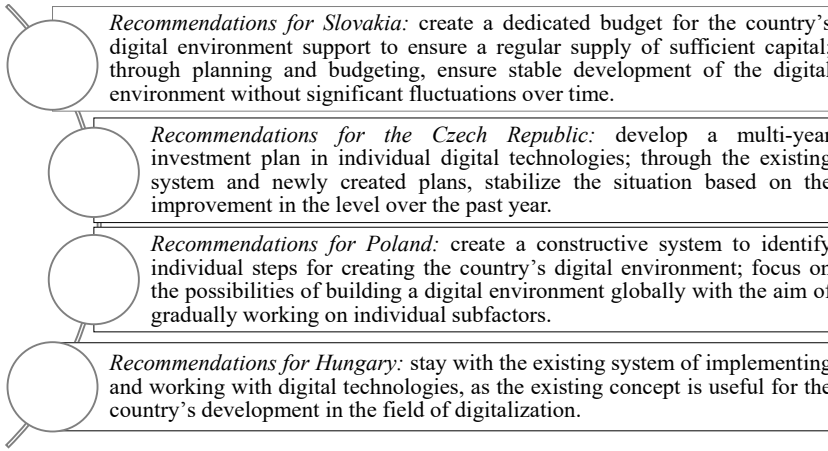

Figure 10. Practical advice from L. Cernanova and F. Stovicek for increasing the digital competitiveness of the countries of Visegrad Four

Source: compiled based on the source [3, pp. 47–48]

The analysis showed that the current understanding of a country's digital competitiveness is multifaceted and complex and requires in-depth study. We used the capabilities of a computer program to build a "Word Cloud" to provide a visual representation of the most closely related concepts and categories to the digital competitiveness of countries (Figure 11).

Such visualization provides additional understanding not only of the factors ensuring the digital competitiveness of countries in the context of globalization and innovation, but also outlines the state of development of the digital economy in individual countries of the world and indicates those areas of socio-economic life of members of society that are undergoing changes under the influence of technical and technological transformations. Thus, the digital competitiveness of a country in the context of digital transformation is focused on the creation and effective use of advanced digital technologies for the benefit of the state and society, ensuring the implementation of a long-term strategy to increase and strengthen the competitive position in the global market, stimulating innovative development and forming the basis for economic prosperity to maintain the well-being of the nation.

Figure 11. Visualization of the categorical apparatus most often associated with the digital competitiveness of countries

Source: constructed based on her own observations

7. Conclusion

The digital revolution inherent in the first quarter of the 21st century is accompanied not only by the large-scale creation and implementation of digital technologies in all spheres of human life and activity, business, and the performance of state functions, but also by the increase in turbulence and instability of relationships in the global economic system, the emergence of new strategic opportunities for the development of economies of countries of the world that do not have sufficient natural resources, but with the advent of advanced technologies have gained a chance for technological and economic leadership. The realities of digital changes in the world no longer simply require, but require the development and implementation of new programs and strategies for the development of individual countries, regions and the whole world, which will create a new format of relationships between people, business and the state, in production and the socio-economic life of members of society, because advanced technologies are qualitatively changing typical formats of life.

Researching the levels of digital competitiveness of countries around the world gives us a broader understanding of the digital inequality and digital divide that arise due to the emergence and spread of digital technologies. This allows us to develop practical solutions in a timely manner to prevent digital threats to national security and achieve sustainable digital sovereignty. A high level of digital competitiveness of a country is now becoming a guarantee of its economic growth and well-being of citizens, creating additional opportunities for their accelerated development, improving the digital quality of life of society and strengthening its socio-economic components. Ultimately, a country's strong competitive position in digital transformation increases its chances of economic, technological and scientific leadership, which in the future forms the basis for building international relations and cooperation with global partners, allows for accelerated digital development and purity of the information space, which are important for the national security of each country.

References:

1. Botti A., Parente R., Vesci R. (Eds.) (2023) *How to do business in digital era? A casebook*. Second edition. Salerno-Cracow: Cracow University of Economics. 146 p. Available at: https://ted.uek.krakow.pl/output-2-the-casebook-how-to-do-business-in-digital-era/ (accessed January 10, 2024).

2. Bris A., Cabolis Ch., Caballero J. (2017) The IMD World Digital Competitiveness Ranking. How does your country rank? *IMD. Research & Knowledge,* September 2017. Available at: https://imd.widen.net/view/pdf/vldyri8qcm/tc050-17.pdf (accessed December 19, 2024).

3. Cernanova L., Stovícek F. (2024) Digital competitiveness of V4 countries. *Ekonomicke rozh'ady – economic review,* vol. 53, no. 1, pp. 32–50. DOI: https://doi.org/10.53465/ER.2644-7185.2024.1.32-50

4. CLOTEX-HUB – pershyi ukrainskyi khab merezhi YeTsIKH [CLOTEX-HUB – the first Ukrainian hub of the ECIH network] (2024) *Diia. Biznes – Diia. Business,* October 31, 2024. Available at: https://business.diia.gov.ua/news/clotex-hub-pershyi-ukrainskyi-khab-merezhi-yetsikh (accessed December 13, 2024). (in Ukrainian)

5. Digital Competitiveness (2024) Lark Editorial Team. *Lark,* April 17, 2024. Available at: https://www.larksuite.com/en_us/topics/digital-transformation-glossary/digital-competitiveness (accessed December 19, 2024).

6. Fedorak V. (2023) Yak vziaty uchast u Prohrami «Tsyfrova Yevropa»: pryklady proiektiv, vidkryti konkursy, pidhotovka proiektnoi zaiavky [How to participate in the program "Digital Europe": project examples, open calls, preparation of a project application]. *U-LEARN,* January 17, 2023. Available at: https://u-lead.org.ua/news/112 (accessed December 13, 2024). (in Ukrainian)

7. Grosu V., Andrioaia I., Tiganas I.-M. (2023) The influence of the digital revolution on sustainable competitiveness. Case study for Eastern European countries. *European Journal of Accounting, Finance & Business,* vol. 11, no. 2, pp. 61–67. DOI: https://doi.org/10.4316/EJAFB.2023.1128

8. Herold D. M. (eds.) (2022) Digital Entrepreneurship Curriculum. Cracow University of Economics, Vienna-Cracow. 57 p. Available at: https://ted.uek.krakow.pl/wp-content/uploads/2022/09/Curriculum_v1_web.pdf (accessed December 20, 2024).

9. Hurduzeu G., Lupu I., Lupu R., Filip R. I. (2022) The Interplay between Digitalization and Competitiveness: Evidence from European Countries. *Societies,* vol. *12,* Art. 157. DOI: https://doi.org/10.3390/soc12060157

10. Khazaei M., Faghihi M., Manesh V. S. (2022) How Performance of Top Companies Are Related on IMD Digital Competitiveness Indicators? *Issues in Social Science*, vol. 10, no. 1, pp. 29–44. DOI: https://doi.org/10.5296/iss.v10i1.20031

11. Kiselakova D., Sofrankova B., Gombar M., Matijova M. (2024) Modelling the impact of innovation performance on digital competitiveness: The key role of innovation and technologies. *Asian Economic and Financial Review,* vol. 14, no. 4, pp. 295–311. DOI: https://doi.org/10.55493/5002.v14i4.5020

12. Ko A., Mitev A., Kovacs T., Feher P., Szabo Z. (2022) Digital Agility, Digital Competitiveness, and Innovative Performance of SMEs. *Journal of Competitiveness,* vol. 14, no. 4, pp. 78–96. DOI: https://doi.org/10.7441/joc.2022.04.05

13. Kraus K. (2024) Global experience of science and technology clusterization in the digital epoch: intellectual and patent activities within economic sectors. *Bulletin of the National University "Lviv Polytechnic". Series "Problems of Economics and Management"*, vol. 8, no. 1, pp. 59–74. DOI: http://doi.org/10.23939/semi2024.02

14. Kraus K. (2024) Interdependence of innovative economy and social inequality in the conditions of digital transformation: a globalization aspect. *Economic Synergy*, vol. 2, no. 12, pp. 8–20. DOI: https://doi.org/10.53920/ES-2024-2-1

15. Kraus K., Kraus N. (2022) Practice of Application of Latest Digital Technologies. *Workshop on Cybersecurity Providing in Information and Telecommunication (CPITS-II-2021),* Art. 3188, pp. 207–213. Available at: http://ceur-ws.org/Vol-3188/short1.pdf (accessed December 19, 2024).

16. Kraus K., Kraus N. (2023) The nature of digital transformation. Energy of the economy. How to feel, understand and use it: Scientific monograph. Riga, Latvia: "Baltija Publishing". 280 p. DOI: https://doi.org/10.30525/978-9934-26-287-6

17. Kuncova M., Berkova K., Frendlovska D., Fureder R., Uberwimmer M., Haas B. (2014) Digital competitiveness in the Czech Republic and Austria. *Interreg. Austria – Czech Republic. European Regional Development Fund.* 12 p. Available at: https://2014-2020.at-cz.eu/data/projects/f/89/673.pdf (accessed December 19, 2024).

18. Laitsou E., Kargas A., Varoutas D. (2020) Digital Competitiveness in the European Union Era: The Greek Case. *Economies*, vol. 8, no. 4, Art. 85. DOI: https://doi.org/10.3390/economies8040085

19. Magliocca P. (Ed.) (2023) *Doing business digitally. A textbook*. Second edition. Foggia-Cracow: Małopolska School of Public Administration, Cracow University of Economics. 250 p. Available at: https://ted.uek.krakow.pl/output-2-the-textbook-doing-business-digitally/ (accessed December 22, 2024).

20. Marcus J. S., Rossi M. A. (2024) Strengthening EU digital competitiveness: stoking the engine. EUI; RSC; Research Report; Centre for a Digital Society. European University Institute. Available at: https://hdl.handle.net/1814/76877 (accessed December 19, 2024).

21. Marti L., Puertas R. (2023) Analysis of European competitiveness based on its innovative capacity and digitalization level. *Technology in Society,* vol. 72, Art. 102206. DOI: https://doi.org/10.1016/j.techsoc.2023.102206

22. Martincevic I. (2021) The correlation between digital technology and digital competitiveness. *International Journal for Quality Research,* vol. 16, no. 2, pp. 541–558. DOI: https://doi.org/10.24874/IJQR16.02-13

23. Mlynarzewska-Borowiec I. (2022) Digital Competitiveness Gap between the US and EU Member States in the 21st Century. *European Research Studies Journal,* vol. XXV, no. 4, pp. 364–380. DOI: https://doi.org/10.35808/ersj/3087

24. OECD (2024) *Increasing resilience by accelerating the digital transformation of business in Ukraine.* OECD Publishing, Paris. 118 p. DOI: https://doi.org/10.1787/5d9e86a7-uk

25. Sagarik D. (2023) Enhancing Digital Competitiveness Through the Lens of Digital Government Among Asian Economies. *International Journal of Public Administration in the Digital Age (IJPADA),* vol. 10, no. 1, pp. 1–11. DOI: https://doi.org/10.4018/IJPADA.326122

26. Sahi S. M. (2022) Impact of the digital competitiveness on economic growth: evidence from global economy. *World Economics & Finance Bulletin (WEFB),* vol. 14, pp. 57–67. Available at: https://www.scholarexpress.net/index.php/wefb/article/view/1340/1199 (accessed December 21, 2024).

27. Santoso F. Y. E., Samputra P. L., Daryanto E. (2024) Digital Competitiveness and Economic Resilience. *Asian Journal of Engineering, Social and Health,* vol. 3, no. 7, pp. 1536–1548. DOI: https://doi.org/10.46799/ajesh.v3i7.353

28. Stankovic J. J., Marjanovic I., Drezgic S., Popovic Z. (2021) The Digital Competitiveness of European Countries: A Multiple-Criteria Approach. *Journal of Competitiveness,* vol. 13, no. 2, pp. 117–134. DOI: https://doi.org/10.7441/joc.2021.02.07

29. Successful projects of the EU program "Digital Europe" (2024) *Diia. Business,* August 12, 2024. Available at: https://export.gov.ua/news/uspishni-proiekty-prohramy-yes-tsyfrova-yevropa (accessed December 13, 2024).

30. Prohrama YeS "Tsyfrova Yevropa" (2021-2027) [The EU program "Digital Europe" (2021–2027)] (2024) *Diia. Biznes – Diia. Business.* Available at: https://business.diia.gov.ua/finance/program/programa_es_cifrova_evropa_2021_2027#block2 (accessed December 13, 2024). (in Ukrainian)

31. The future of European competitiveness. Part A. A competitiveness strategy for Europe (September 2024) *European commission.* 66 p. Available at: https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en (accessed December 19, 2024).

32. World Digital Competitiveness Ranking 2023 (2024) *IMD. World Competitiveness Center*. Available at: https://www.imd.org/wp-content/uploads/2023/12/Digital_2023.pdf (accessed December 14, 2024).