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TRENDS IN THE DIGITAL TRANSFORMATION OF UKRAINE'S ECONOMY IN THE CONTEXT OF WAR

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Abstract. Influenced by the processes of global digital transformation and the requirements set by the European Union in the context of European integration, the Ukrainian economy, even before the full-scale invasion, was focused on the development of digital technologies that allow increasing the level of production automation and labour productivity, reducing costs, increasing revenues, improving competitiveness and realising other benefits of digitalisation. At the same time, during the war, the role of digital technologies is growing, turning into a flexible tool that ensures the economic sustainability of Ukraine. Despite the considerable attention of researchers to the problems of building Ukraine's digital economy in wartime, the key features and trends of its development require a more detailed study, taking into account the challenges and tasks that arise in martial law and can be quickly and effectively addressed with the help of digital technologies. In this regard, the study of the specifics of the development of digital transformation of the economy in order to achieve Ukraine's strategic goals in wartime deserves special attention. The *subject* of the study is the process of digital transformation of Ukraine's economy in wartime. The purpose of the study is to analyse the features and trends in the development of Ukraine's digital economy, taking into account the challenges and needs of wartime, and to propose ways of post-war recovery. The study of the problem was carried out with the use of a combination of general scientific and modern research methods, among which the main ones are the method of system analysis (when studying the approaches and points of view of domestic and Western scientists), economic and statistical (to determine the trends in the development of the digital economy in Ukraine), analysis and synthesis (when studying the types of digital economy), graphic (to visualize a number of theoretical and practical provisions of the article). The *purpose of the article* is to study the peculiarities of development of Ukraine's digital economy in the context of current challenges caused by the war. The authors emphasises that digitalisation processes are important for the restoration and development of the national economy and for increasing the country's competitiveness. The importance of further development of the digital economy is determined not only in the context of war, but also to overcome its consequences in the period of post-war recovery. *Conclusions*. Digital technologies have a significant potential to restore the national economy and accelerate economic development, as they can facilitate the transition from the use of material to information resources, reduce production costs, create new technological products and bring them to the global market, increase the country's competitiveness, etc. In addition, digital technologies can accelerate Ukraine's economic development both during the war and in the period of post-war reconstruction. This contribution is supported by the research work of the Department of Accounting and Taxation of the National University Zaporizhzhia Polytechnic 05711 "Modern concepts and practice of development of accounting, auditing and taxation in the context of economic globalization".

Keywords: digital economy, digitalisation, war, martial law, digital technologies, digital tools.

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1. Introduction

In the second year of a full-scale war, the country's economy is undergoing a transformation. On the one hand, this is a time when old innovations are being destroyed, and on the other, new ones are rapidly developing. It is digital technologies that improve and facilitate the work of companies that provide financial, banking, government and municipal services, as well as the production of military equipment. Despite the war, the number of treasury, budgeting, costing and controlling projects has grown significantly. It is the digital economy that is accelerating socio-economic life in the modern world, and it is the economy that can rapidly increase the country's GDP. A comprehensive and ambitious strategy for the digital transformation of the economy can become one of the main principles for coordinating economic development efforts. This strategy should address a number of key issues, such as the acquisition of digital skills, the development of digital infrastructure, the digitalisation of public services, and the digital transformation of the business environment in Ukraine. Ukraine needs a "digital leap", in which the scale and pace of digital transformation should become key features of the country's development. Thus, the digital transformation of the economy is not a fashion or a whim, but a necessity and the basis of the country's future.

An analysis of recent studies and publications that have begun to address this issue shows its relevance. The issue of developing the digital transformation of the economy is relevant and is being studied quite actively. The theoretical foundations of the formation and functioning of the digital economy have been studied in the works of national scholars such as S. Bolila (Bolila, 2023), K. Kovtoniuk (Kovtoniuk, 2017) A. Kosach (Kosach, 2022) V. Liashenko (Liashenko, 2018). The theoretical and practical aspects of the digital transformation of the economy were considered by P. Nikiforov (Nikiforov, 2022), K. Shaposhnikov, O. Holovko (Shaposhnikov, Holovko, 2019) and others. Trends and prospects for the development of the digital economy are analysed in the works of N. Kraus and O. Holoborodko (2018). The development of the digital transformation of the economy is considered in the works of foreign scholars, such as W. Chen, Y. Wu, (Chen, Wu, 2022). ZL Miao (ZL. Miao, 2021), E. Osmanbegovic, N. Piric (Osmanbegovic, Piric, 2019).

Despite the considerable attention of researchers to the problems of developing the digital transformation of Ukraine's economy in times of war, the key features and trends of its development require a more detailed study, taking into account the challenges and tasks that arise during the war and can be quickly and effectively addressed with the help of digital technologies. In view of this, the study of the specifics of the development of digital transformation of the economy in the direction of achieving Ukraine's strategic goals in the context of war deserves special attention.

2. The Economic Essence of the Digital Transformation of Ukraine's Economy in the Context of War

The digital economy, as the main feature of modernity, affects all spheres of society. As a trend in the development of the economy and society, digitalisation has a different impact on different areas. And it is the degree of digitalisation's impact on the national economy that determines the place of each country in the global community.

The global process of digital transformation of the economy is uneven and different in different countries. One of the important indicators of digital transformation is the Digitalisation Index. At the same time, as the world becomes more politically and economically decentralised, consumers, services, technological processes and businesses continue to be digitised. Growing digital integration and economic nationalism are shaping a new model of globalisation. This model is characterised by a decline in the dynamics of international trade in traditional goods and services in favour of information and IT services (Bolila, 2023).

The digital economy encompasses businesses in all sectors of economic activity, i.e., not only in the information and telecommunications sector, but also in basic industries, agriculture, construction, etc. The digital transformation of the economy is one of the main drivers of economic growth in the next 5-10 years. In addition to the direct productivity gains that companies get from digital technologies, there is a chain of indirect benefits of digitalisation, such as time savings, creation of new demand for new goods and services, new quality and value, etc.

In his works, N. Kraus notes the following: "Digitalisation should be seen as a tool, not an end in itself. With a systematic state approach, 'digital' technologies will stimulate the development of an open information society as one of the most important factors in increasing productivity, economic growth, creating jobs and improving the quality of life of Ukrainian citizens." (Kraus, 2018)

Digitalisation is an undeniable driver of the development of modern society and all its components. It brings many benefits to the labour market and economic growth. It is considered an axiom that investing in a digital asset is much more profitable than in a non-digital one, and digital-

related sectors show a greater increase in labour force than the economy as a whole (Liashenko, 2018).

Ukraine needs to launch a large-scale digitalisation of all sectors of the economy and basic spheres of life, investing as much as possible in the development of digital infrastructures, innovations and modern technologies. The digital economy is the accelerator of socio-economic life in the modern world, and it is the one that can rapidly increase the country's GDP.

Today, the war in Ukraine has caused many problems for the Ukrainian economy. The difficult current conditions should not be a reason to abandon the implementation of digitalisation, but rather should stimulate this process because of the future prospects. Digital transformation can generally be rationalised in three global areas: document management, data analytics, and organisational performance.

The digital transformation of the economy is the future of both the global and Ukrainian economies. In a time of war, this is the only way for the Ukrainian economy to remain resilient and continue to grow. It is digital transformation that makes the economy competitive in the market. Over time, digital transformation will penetrate all sectors of the economy. This process will help to optimise both core and auxiliary business processes, and for Ukraine, solve key problems in the context of war (Nikiforov, 2022).

The vision of Ukraine's future is full digitalisation. It envisions a country with a world-class tax system, advanced defence technology and efficient public administration. The ambitious goal is to have all public services available online by 2030, and this year a significant push will be made to digitise key services.

The digital transformation of Ukraine's economy is a global opportunity for the economy to join the modern changes enabled by digitalisation. Thus, the study found that in times of war, the transformation of such businesses with the help of modern digital technologies plays a special role in supporting the functioning and development of the business.

3. Analysis of the Digital Transformation of the Economy in the Context of Russia's Invasion of Ukraine

In the context of Russia's full-scale invasion of Ukraine, digital transformations in Ukraine in September 2023 were aimed at expanding digital opportunities to achieve the resilience of the national economy. In particular, this includes Ukraine's integration into the EU's Digital Single Market, building digital infrastructure, attracting investment, creating a register of damage caused by Russia's aggression against Ukraine, etc.

Stimulating digital transformation and reviving Ukraine's economy will be facilitated by applying for funding for digital global gateway projects under the EU's Connecting Europe Facility programme worth about €6 billion, the total cost of which is divided into four key areas (Ministry of Digital Transformation of Ukraine):

– High-performance computing – 2.2 billion EUR (projects related to the computation of large amounts of data for decision-making in the economy, defence and healthcare);

– AI and cloud services – 2.1 billion EUR (projects that provide products created with the help of artificial intelligence to facilitate the work of enterpri-ses, public administrations and research institutions);

– The use of digital technologies in the economy and society – 1.1 billion EUR (projects that implement digitalisation in business, e-government, healthcare, environment, education and culture, as well as Smart City technologies);

– Digital skills – 580 million EUR (projects for acquiring new skills in the IT sector);

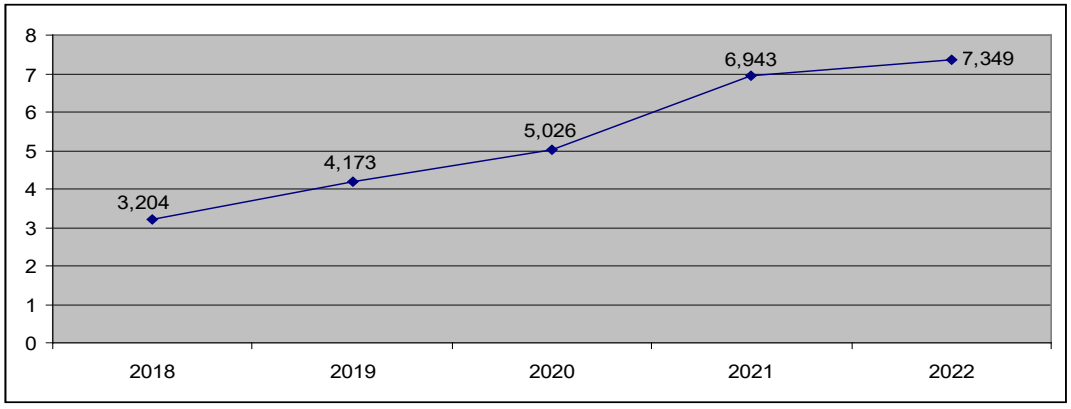

Figure 1. Export dynamics of the Ukrainian IT industry

Source: compiled by the authors based on data from (Ministry of Digital Transformation of Ukraine)

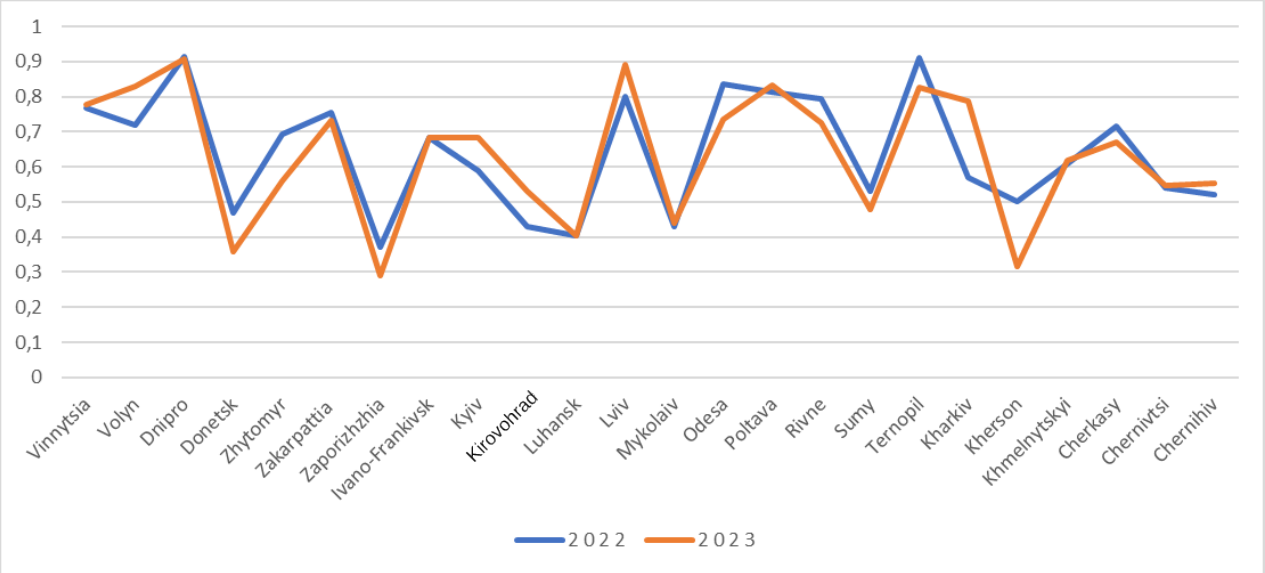

Figure 2. Indicators of the Digital Transformation Index of Ukrainian oblasts in 2022–2023

Source: compiled by the authors based on data from (Chen, Wu, 2022)

– Cybersecurity. At the end of 2022, this industry brought 7.35 billion USD or 4.5% of total GDP to Ukraine's economy (Figure 1).

In times of war, digitalisation is an effective tool to fight corruption, including through the digitalisation of public services, which helps reduce the impact of the human factor. According to the Cabinet of Ministers of Ukraine, as of September 2023, the anti-corruption effect of digitalisation amounted to over 16 billion UAH. Business opportunities such as the eEntrepreneur programme and the Diia.City tax and legal space have proved particularly anti-corruption. The IT industry has also proved to be quite resilient during the war, thanks to its ability to provide employees with the opportunity to work remotely and quickly adapt to the challenges of the day.

The priority area for the development of the digital economy in Ukraine in times of war is the military-technical sector, which includes the development of unmanned aerial vehicles (UAVs), inventions in the field of navigation systems, intelligence, armaments, logistics and army support, etc. Digital technologies, such as artificial intelligence, robotics, cyber systems, cloud technologies, etc., are becoming extremely relevant for the military sector, which needs innovative military developments in a short time.

In contrast to the information and communication technology sector, the development of Ukraine's science and innovation sector has been less encouraging. Currently, Ukraine is among the countries lagging behind in global innovation rankings. For example, according to the Global Innovation Index (2022), Ukraine ranks 34th out of 39 European countries, and in the Global Digital Competitiveness Ranking (2021), it ranks 54th out of 64 countries. The reasons for this can be explained by insufficient funding for research, inefficient organisation of the scientific sector and problems with intellectual property protection.

According to the Ministry of Digital Transformation of Ukraine, the average value of the Digital Transformation Index in 2023 was 0.632 points, with the highest values recorded in Dnipropetrovsk (0.908), Lviv (0.891) and Poltava (0.833) regions, and some regions showing positive dynamics in this indicator (Figure 2).

In Ukraine, significant attention is paid to digitalisation not only at the national but also at the regional level. Thus, digital projects relevant to martial law have been implemented in a number of regions using various sources of funding (Table 1).

Digital trends or tendencies reflect the direction of development of digital technologies. Analysing these trends makes it possible to predict the development of a particular economic, technological and even social phenomenon in the future (Kosach, 2022).

Information turns into a valuable resource. Collecting, describing, storing and processing data provides important information that can be used in business processes, social life and public administration. Data skills and data analysis are becoming key to obtaining valuable market information that makes companies more competitive. Access to data is provided through the Internet and other networks. Much of the world's data is becoming or already is open.

Thus, the domestic information technology market and the digital transformation of Ukraine

Table 1

Regional projects in the field of digital transformation of Ukraine under martial law

Project name, region and year of implementation	USD
Energy-Independent Administrative Services Centre, Vinnytsia Oblast, 2023	7 602,86
Energy-Independent Administrative Services Centre, Volyn Oblast, 2023.	127 197,20
The "I am a veteran" programme, Dnipropetrovsk Oblast, 2023	81 805,84
Digital education centres, Zhytomyr Oblast, 2023	144 247,52
Accessible remote education, Zhytomyr Oblast, 2023	223 175,40
Increasing hromada resilience, Zakarpattia Oblast, 2023	127 026,62
E-service to prepare the population for national resistance, Zakarpattia Oblast, 2023	Without attracting investments
Safe Kyivshchyna, Kyiv Oblast, 2023	1 329,1
Flight City 4.0 technology park, Kirovohrad Oblast, 2023	300 000,0
Coworking Space STEM, Luhansk Oblast, 2022	25 109,99
Accounting system for the distribution of humanitarian aid to IDPs, Luhansk Oblast, 2022	2 703, 72
Air defence (drones + AD), Odesa Oblast, 2023	6 804,13
Online platform for IDPs' humanitarian needs, Ternopil Oblast, 2023	537,74
Interregional Data Centre, Ternopil region, 2022	26 349, 47
Interactive map of IDPs' needs, Khmelnytskyi Oblast, 2023	1 957, 22
Energy-Independent Data Center of the EMB, Chernihiv Oblast 2023	27 286,61
Cybersecurity of information resources of the Unified Information System of Public Administration, Chernihiv region, 2023	163 611,67

Source: compiled by the authors based on data from the Ministry of Digital Transformation of Ukraine

Table 2

Developing trends in Ukraine's digital economy: barriers and opportunities

Barriers	Opportunities
Lack of a system of rules, regulations, standards for data collection, classification, storage and use (at national, regional, sectoral and other levels)	Development of a new sector of the economy, new jobs
Intellectual property protection issues	Creation of a framework for the development of all industries and the digital economy
Data protection issues, cybersecurity risks	Emergence of an effective management tool
Lack of sufficient data competencies (digital skills), relevant education, professions, and so forth	Creating an environment that makes corruption impossible as a phenomenon

are considered as a single system in terms of management, organisational, investment, financial and other efforts. The harmonious development of both spheres based on market mechanisms and "smart activity" of the state can allow the economy and spheres of life to make significant steps forward within a few years, reducing the timeframe for achieving significant changes from decades to several years and facilitating the so-called digital leap.

Thus, the global economic transformation opens up unprecedented opportunities for acquiring new knowledge, broadening horizons, learning new professions and improving skills. New social perspectives are emerging that expand geographical opportunities. More comfortable cities, efficient government institutions and accessible public services improve the daily lives of citizens.

4. Ways of Post-War Recovery of Ukraine's Economy in the Context of Digital Transformation

Before the outbreak of the war, Ukraine's information and communications technology industry had already achieved significant success and was recognised as the "new tiger of Europe". With over 200,000 highly skilled professionals, the sector contributes 4% of the country's gross domestic product. Ukraine is also one of the largest exporters of information technology services in the world. Prior to the conflict, segments such as outsourcing, cybersecurity, artificial intelligence, mobile apps, blockchain and e-government were booming.

At the same time, digital transformation is covering all sectors of Ukraine's economy,

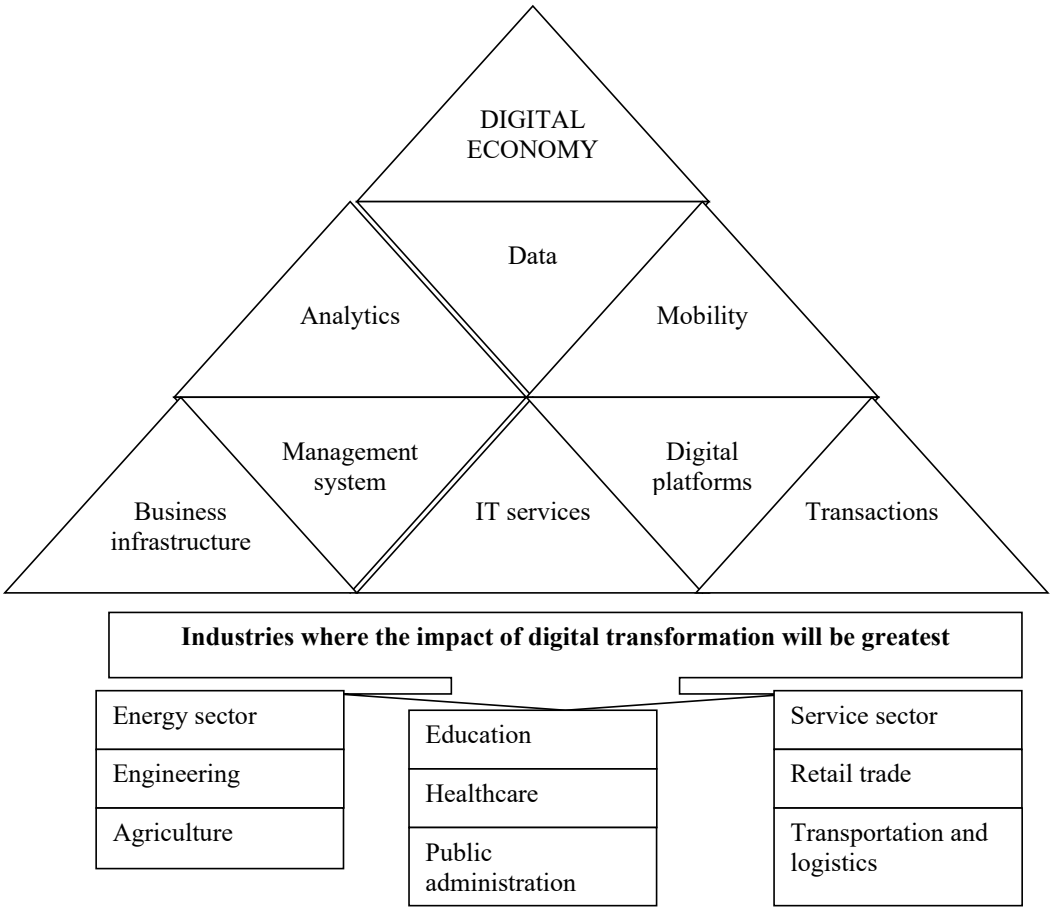

Figure 3. Elements of the digital transformation of Ukraine's economy

Source: authors' development

introducing digital solutions in many industries, including banking and finance, agriculture, food production, energy, etc. In the context of the conflict, digital transformation has become a key element for the people and economy of Ukraine, facilitating not only the provision of basic services such as banking, electricity and water, but also adapting government digital platforms to deliver educational and public services, which are critical in a war-torn environment.

Digital transformation will also be a necessary part of the economic recovery and modernisation process. Similar to the principles of greening, transparency, gender and social inclusion, digital transformation should be seen as an important component of post-war recovery, and Ukraine should use digital measures to achieve this goal.

In his works, P. Nikiforov notes that "under martial law, Ukraine is forced to reorient its focus from the development of artificial intelligence, the Internet of Things and robotics to the reconstruction and restoration of damaged or destroyed elements of digital infrastructure, strengthening the country's information and cyber security. Despite the military challenges and threats, digitalisation remains one of the top priorities for the development of both the national economy as a whole and private companies." (Nikiforov, 2022)

The success of the digital sector before the outbreak of war and its resilience during the conflict indicate the potential for modernisation in all sectors of the country. This strength can have a significant positive impact on Ukraine's GDP and contribute to the necessary stability of the post-war economy. Ukraine actively supports cooperation in the field of digital transformation and is ready to share its experience and solutions with the world. An example of this capacity is the pilot project of a national mobile application based on the Diia programme for interaction with government digital services. Digital transformation is also an important tool for improving accountability and transparency mechanisms in the reconstruction process, and is a catalyst for modernisation. One of the goals for the next stage of Ukraine's recovery is to increase the IT sector's share of GDP to 10% (Figure 4).

Digital transformation in Ukraine is a key driver of economic modernisation. Even during the war,

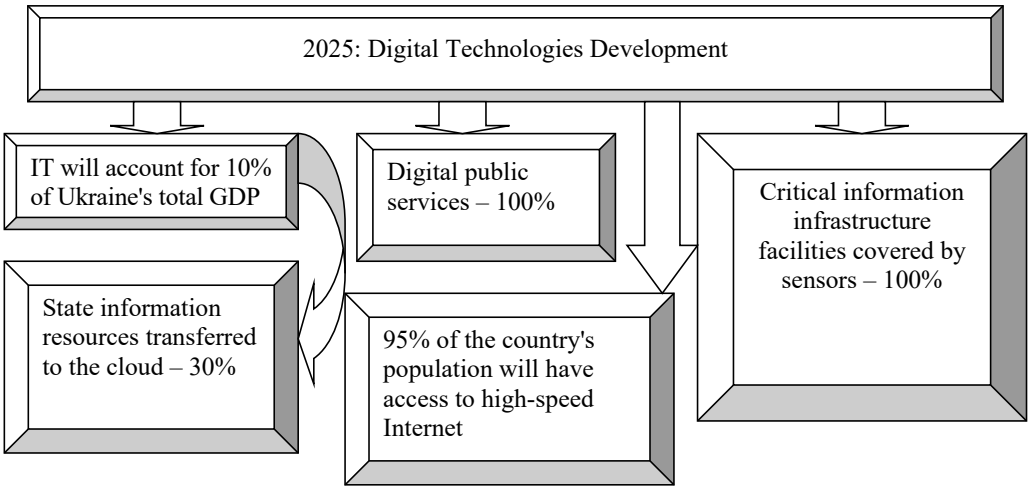

Figure 4. Goals of state support for Ukraine's digital recovery by 2025

Source: authors' development

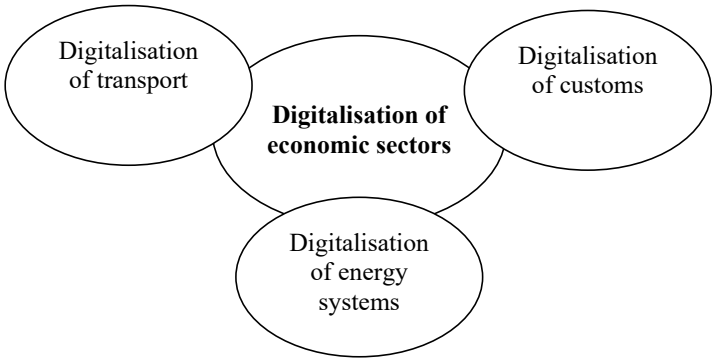

Figure 5. Directions of digitalisation of Ukrainian economic sectors

Source: authors' development

the digital sector has continued to impress with strong growth and remarkable resilience. Investments in digital technologies will influence the entire recovery process, increasing efficiency and reducing costs across industries. Ukraine's digital transformation covers all sectors of the country's economy.

Electronic services allow citizens to conduct business from anywhere in the world, including online lending. After regaining control of the territory, telecommunications systems will be restored first, and the IT industry will contribute to the modernisation of certain regions. Financing the digital sector will help increase productivity and strengthen the resilience of other industries (Kovtoniuk, 2017).

Expanding Ukraine's ties with its Western allies through trade and logistics is a key component of recovery, and efficient customs systems are a critical element. The digital transformation of customs can automate clearance processes, support risk management processes and verify procedures for border control authorities and customs officers. The use of digital trade documents instead of paper can reduce the cost and time of cross-border transactions. The introduction of passport controls for the entry and exit of passengers can be facilitated by mobile passport control systems, where passengers can provide their identification and customs declaration information via a mobile application. Cross-border connectivity through ICT networks can also facilitate communication capabilities between cross-border regulators, harmonising customs services around the world.

The digital transformation of the economic sector should be seen as a tool for new development steps, not as an end in itself. With a systematic governmental approach, digital technologies for economic development can help stimulate job creation, increase productivity, and accelerate the country's economic development (Bolila, 2023).

Digital transformation contributes to the development of the information society and media. The creation of content tailored to national or regional needs contributes to social, cultural and

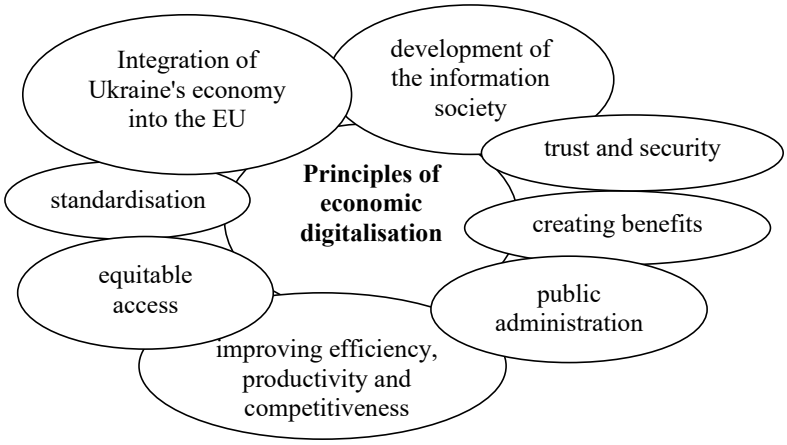

Figure 6. Principles of digitalisation of the Ukrainian economy

Source: authors' development

economic development, as well as to the strengthening of the information society and democracy.

Digital transformation should focus on international, European and regional cooperation aimed at Ukraine's integration into the EU and access to the global market. Standardisation is the foundation of digital transformation and a key factor in its successful implementation.

Digital transformation must be accompanied by an increased level of trust and security, in particular with regard to information security, cybersecurity, personal data protection and the rights of digital users (Osmanbegovic, 2019).

The government is a key actor in the digital transformation process, with the responsibility to set up market mechanisms, overcome institutional and legislative barriers, implement digital transformation projects, and attract investment. Businesses will see a significant increase in the return on investment in digital technologies compared to traditional ones, according to Digital Spillover, where the return on investment in digital technologies is 6.7 times higher. Every dollar spent on digital technologies leads to a 20 USD increase in GDP, meaning that the investment multiplier is 20 USD. By comparison, the multiplier for traditional investments is 2-8, depending on the industry. Thus, digital transformation promises significant benefits for key stakeholders.

The implications of digitalisation for Ukrainian business include the following:
– Industrial production growth of 7-10% annually;
– growth of high-tech segments up to 20% annually;
– increase in production productivity by 60%;
– increase in the number of orders completed on time to 95%;
– reduction of inventory by up to 20%;
– increased efficiency of installed equipment by up to 15%;
– reduction of equipment downtime by up to 22%;
– reduction of procurement costs by up to 30%.

Thus, the article concludes that the macroeconomic effect is determined by assessing the impact of

Table 3
Expected impact of digitalisation on the Ukrainian economy

Indicator	2021	2025*	2030*	Total in 2021–2030*
Investments in digital infrastructure	0.7 billion USD	3 billion USD	6 billion USD	16 billion USD
Investments in the digitalisation of production, business and industry	1,5 billion USD	5 billion USD	14 billion USD	70 billion USD
Increase of labour productivity through digitalisation	+1,1%	+13%	+13%	
Additional GDP generated by digitalisation	17 billion USD	93 billion USD	280 billion USD	1 260 billion USD
Additional GDP in %	+11%	+44%	+95%	
Additional budget revenues	3,2 billion USD	17 billion USD	50 billion USD	240 billion USD
Number of jobs created (excluding the export IT industry), people	150 000	300 000	700 000	
Share of the digital economy in Ukraine (in total GDP)	3%	15%	65%	

Source: authors' development

investments in digital technologies and digital infrastructure on GDP, as well as by assessing the growth of labour productivity due to digitalisation.

5. Discussion

Analysing the results of the research, it should be noted that the conditions for the digital transformation of Ukraine's economy depend on a number of factors that need to be taken into account, both those that facilitate the digital transformation of the country's economy and those that slow down its implementation. The factors that contribute to the digitalisation of the country's economy include the following: engagement of experienced professionals with experience in implementing digital transformation in the EU; implementation of Ukraine's regulatory framework in accordance with European legislation; introduction of IT technologies that create new criteria for assessing the effectiveness of tasks and solutions of systems and organisations that ensure the modern implementation of digital tools. These factors require the elimination of negative and harmful conditions that affect the country's economic development, including its digitalisation, namely: ending the war in Ukraine; regulatory and legal support for economic development.

6. Conclusions

The digital transformation of Ukraine's economy is a modern reality, the development of which depends on a number of factors, the implementation of which ensures its sustainable development. Digital transformation is the future not only of the Ukrainian economy but also of the global economy. During the war in Ukraine, the digital transformation of the economy is the only way to maintain resilience and continue to develop.

The digital transformation of the economy in times of war is necessary to ensure the functioning of infrastructure, uninterrupted access to education and training, provision of medical services, improvement of cybersecurity and support for the country's economic front in general.

Promising ways to accelerate the digital transformation of the national economy and improve its competitiveness include increasing funding for the introduction of new digital technologies in the real economy, transition to digital business models, improving the legal framework for the digital economy and regulatory practices, and developing special programmes to improve digital and financial literacy. Thus, Ukraine needs to address the main challenges on the path to digitalisation, such as launching digital transformation projects at the national level and attracting the necessary investments. It is also important to promote the development of digital infrastructure, introduce changes to existing governance models, and reformat communications, technology, and organisational structure. These changes should be based on the principles of partnership, customer focus, innovation and synergy. The digitalisation of the economy should become a strategic direction and a key factor in Ukraine's economic recovery.

Given the challenges posed by the war, investments should become the basis for the recovery and further development of Ukraine's economy. The widest choice of investment types is offered by the digital transformation of the economy, which is so widespread in society that digitalisation is driving new paradigms, concepts and approaches to management in general.

The digital transformation of Ukraine's economy is a global opportunity to contribute to the strengthening and development of a country that is on the verge of a digital renaissance. Active participation in these processes can provide an economic leap forward that will help secure a more promising and technologically advanced future for Ukraine, as well as contribute to the development of the global technology community.

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