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Digitalization trends and expectations in Ukraine from a European perspective

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Abstract. *This paper examines the comprehensive digital transformation initiatives undertaken by the Government of Ukraine between 2020 and 2025, focusing on policy frameworks, infrastructure development, and strategic planning in various sectors. Through legislative measures and infrastructure projects, Ukraine has positioned itself as a leader in digital innovation, with a particular emphasis on artificial intelligence (AI) integration. The adoption of AI technologies across education, economics, cybersecurity, defense, public administration, and legal regulation demonstrates a concerted effort to modernize and optimize key aspects of governance and economic activity. Furthermore, Ukraine's collaboration with European institutions and participation in initiatives such as the European Open Science Cloud (EOSC) and the Digital Europe program highlight its commitment to aligning with European standards and fostering international cooperation. The paper also discusses the role of international support, particularly from the European Union and USAID, in bolstering Ukraine's digital resilience and innovation ecosystem. Through strategic partnerships and domestic initiatives, Ukraine aims to harness the potential of digital technologies for economic growth, societal advancement, and resilience against emerging threats.*

Keywords: Digital Transformation, Artificial Intelligence (AI), Infrastructure Development, European Integration, Cybersecurity, Ukraine

Introduction

Digitization in Ukraine has gone through a significant historical path, from the initial steps towards the introduction of information technologies to the full transformation of the economy and society in the digital age. Key stages of this development and current trends determining the current state of digitization in Ukraine are discussed below.

Stage 1: Beginning of informatization (1990-2000s). In the period after Ukraine gained independence in 1991, the first steps towards the introduction of information technologies were initiated. This stage was characterized by initial initiatives in the creation of electronic management systems and automation of enterprise activities.

Stage 2: Development of the Internet and e-commerce (2000-2010s). In the 2000s, with the advent of the Internet in Ukraine, the processes of electronic communication and electronic

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commerce intensified. Enterprises and institutions began to actively use the Internet to conduct business operations and communicate with customers.

Stage 3: Transition to e-Government (2010-present). In the following period, emphasis was placed on the introduction of electronic government and digitalization of public services. Government and municipal bodies are actively implementing electronic management systems, electronic services and portals to provide access to public services online. This period is characterized by active efforts of the state to implement innovative technologies in order to improve the availability and quality of services for citizens and businesses.

In the third stage of the development of digitalization in Ukraine, significant progress was made in the direction of the introduction of electronic government and digitalization of public services. The government and municipal bodies are actively moving to the use of electronic management systems, which simplifies and accelerates decision-making processes and the provision of administrative services. There are more and more electronic services that can be accessed online through special portals and applications. This covers a wide range of services, from filing tax returns to obtaining medical services. Implementation of electronic identification systems of citizens, such as an electronic passport and a system of electronic identification of keys, which allows to ensure the security and confidentiality of information.

The state is actively developing open data systems, providing citizens with access to important information about government activities, budget expenditures, statistics, and more. As a result the PROZORRO system has been introduced. PROZORRO is an electronic procurement system created in Ukraine to ensure transparency, efficiency and fight against corruption in the field of public procurement. The process of creating PROZORRO began in 2014 after the Revolution of Dignity, which opened up new opportunities for reforms in the field of public administration. PROZORRO uses electronic technologies to conduct all stages of the procurement process, from planning to contracting. All procurement data, including announcements, tenders and awarded contracts, are publicly available in real time. PROZORRO creates a competitive environment for procurement participants, which helps reduce prices and improve the quality of services and goods. The use of electronic technologies allows procurement to be carried out quickly and efficiently, reducing bureaucratic obstacles and time costs. PROZORRO implements verification and control mechanisms that help prevent corruption and abuses in procurement. The system is constantly improving and introducing new technologies to increase the efficiency and transparency of the procurement process. PROZORRO has become a key tool for the transformation of the public procurement system in Ukraine, providing an important step towards creating an open and transparent business environment.

This stage reflects the importance of digitalization to improve the efficiency of public administration and the provision of services to citizens, contributing to the development of a modern and transparent government.

In this period the “Diia” (in Ukrainian “Дія”) platform and mobile app were introduced (first presentation in 2019 and the official release on February 6, 2020) to fulfill needs of

eGoverment. The “Diia” application is an innovative and unique tool designed to facilitate interaction between citizens and the state in Ukraine. It enables citizens to perform a wide range of administrative services and transactions online, avoiding queues and bureaucratic obstacles. The user can access a variety of government services, such as filing applications, paying taxes, registering with medical institutions, and much more. The app also provides an opportunity to receive notifications from government agencies and receive up-to-date information. “Diia” allows users to store and manage their electronic documentation, such as passports (IDs), driver's licenses and other documents confirming their rights and status.

The “Diia” application is an important step forward in the direction of state digitization in Ukraine. Its implementation opens up new opportunities for citizens in interaction with the state and contributes to the creation of a more accessible, efficient and transparent administrative environment.

Digitization in Ukraine continues to actively develop, creating new opportunities for economic growth. However, there are challenges such as cybersecurity and internet accessibility that need attention and solutions to achieve the full potential of digital transformation in Ukraine.

Current digitization trends and projects in Ukraine

Online services are becoming more and more accessible and widespread, covering various areas of life – from medicine and education to finance and administration. The implementation of AI in the business and public sector contributes to the automation of processes, increased productivity and improved services. As the number of digital threats increases, so does the importance of cyber security. Ukraine is actively developing its cyber defense and cyber intelligence measures. The implementation of IoT technologies in manufacturing, transportation, health care and other areas of life is becoming more and more common, contributing to increased efficiency and comfort.

There are initiatives for the introduction of electronic voting and electronic governance, which contributes to the involvement of citizens in decision-making processes and ensuring the transparency and legitimacy of power structures.

From 2020 to 2025, the Government of Ukraine initiated and implemented the following steps:

- Identified the state as the main player in the sector. The state became a key consumer and user of innovations, formed a fashion for digital culture, popularized education in the hi-tech sector.
- Legislated the basic digital rights of a citizen.
- Implemented infrastructure projects (connection to fixed broadband Internet of all households, building smart infrastructure, etc.).
- Initiated and implemented numerous digital transformation projects (e-government, smart cities, electronic identification of citizens, electronic customs, etc.).
- Created conditions for the emergence of more than 300,000 new jobs in the sectors of the digital economy.

- Implemented publicly available universal digital services for citizens (standard mandatory minimum): education, medicine, transport, security.

In essence, the state transformed itself, its internal administration, political life, internal organization in such a way that everything was built on innovative solutions. Realizing the effect digitalization can have on business, citizens, and ultimately the budget, the political elites formed a new agenda and literally imposed a digital culture in the country.

According to the estimates provided in Chapter 1 of the Strategy "UKRAINE 2030E", the share of the digital economy in the GDP of the world's largest countries will reach 50–60% in 2030. In Ukraine, this indicator, according to the estimates, can be even higher — 65% of GDP (under the implementation of a forced scenario of the development of the digital economy in Ukraine) (UIF, 2020).

A pivotal strategic undertaking in the realm of Information and Communication Technology (ICT) is the formulation of the Concept for the advancement of artificial intelligence (AI) in Ukraine. In December 2020, the Cabinet of Ministers gave its approval to the AI development concept, outlining the roadmap until 2030. This concept represents a significant stride for Ukraine, serving as a catalyst for the infusion of innovative technologies into crucial sectors of the state's economy. Encompassing nine distinct domains of application, the concept outlines the integration of artificial intelligence in areas such as education and science, economics, cybersecurity, information security, defense, public administration, legal regulation, and justice (KMU, 2021).

Education and science. One of the main goals of the development of artificial intelligence in education is the education and training of highly qualified specialists. Creating courses for teachers on working with the basics of AI, developing digital literacy (using digital tools to solve applied problems, searching for information on the Internet, protecting personal data, media literacy, etc.). State stimulation of scientific research in the field of AI, support scientific cooperation with international research centers.

In economics, the implementation of the concept is planned through stimulating the development of entrepreneurship in the field of AI (improving the business climate, ensuring the expected tax policy, developing computing infrastructure, etc.).

In the field of cybersecurity, with the development of AI, it is planned to create national information systems, platforms and products to protect communication, information and technological systems.

In the field of information security, the use of AI will help ensure national interests. In particular, they will identify, prevent and neutralize information threats.

Artificial intelligence in the field of defense is planned to be used in command and control systems, weapons and military equipment, collecting and analyzing information during combat operations, reconnaissance, countering cyber threats in the field of defense, and analyzing the capabilities of troops.

In the field of public administration, AI technologies will be used for digital identification and personal verification, in the field of healthcare and analysis of performance indicators of public administration, to identify dishonest activities of officials.

In the field of legal regulation, AI will try to integrate European standards into Ukrainian legislation, which will improve the provision of legal assistance to Ukrainians (KMU, 2021).

They also plan to develop artificial intelligence in Ukraine in the field of justice, developing already existing technologies – Electronic Court, Unified Register of Pre-trial Investigations, etc.

European trends and expectations from Ukraine

A positive pro-European asset for Ukraine over the past two years has been Ukraine's entry into the European Open Science Cloud Council (EOSC) in 2020, which is the official working group of the Strategic Configuration of the Horizon 2020 program (EOSC, 2024b). The European Open Science Cloud (EOSC) is an ambitious European initiative seeking to generate a pan-European Digital Platform to support open science and research. EOSC is presented to enable European researchers, scientists, and institutions to recharge, access, and collect research data and resources more efficiently (EOSC, 2024a).

One of the key network organizations for supporting innovative business in the EU is European Business Angels Network (EBAN). EBAN is the pan-European representation for the early stage business investor community. The organization brings together more than 150 member organizations from more than 50 countries. The main activities of the organizations are intensive communication through specialized events, research, collection and exchange of data with community members. Establishing interaction between the domestic ecosystem of innovation, ICT and startups with other international and European similar ecosystems and networks of financial support for innovative development (European Network of Business and Innovation Centers EBN, Business Angels of Europe BAE , European Crowdfunding Network ECN) is a priority. EuroQuity platform for accessing investors and players in the business and ICT support ecosystems can be a useful tool for entering business angel networks in the EU. It is imperative to consider the possibility of government support for the development of business angel ecosystems in the country. Tax incentives and co-investment schemes are possible ways for the government to support domestic business angels. However, the creation of national programs to support business angels and the selection of support tools should be carried out in close cooperation with the local business angel community and international communities that have experience in comparing the effects of using different tools in different countries. Forms of crowdfunding based on loans and shares can become an effective tool for Ukraine, but for this it is necessary to develop the regulatory framework for crowdfunding in accordance with EU best practices (EBAN, 2024).

It is becoming critically important for domestic innovation, ICT and startup ecosystems to interact with other international and European ICT innovation ecosystems to help early-stage

investors select promising startups, increase success rates and reduce risks. Angel networks, compared to stand-alone investing, involve resource sharing, pooling of funds, matching funding, scholarships, and greater market influence or easier access.

The strategic activity plan of the Ministry of Economic Development, Trade and Agriculture of Ukraine for 2022-2024 (KMU, 2022) provides, among other things, the creation of a national online platform (online support center) for small and medium-sized businesses. As well as creation of a national network of 24 effective innovative business incubators ("IBI") according to the standards of the European Enterprise Network ("EEN") at the expense of local budgets and foreign partners. Together with expanding Ukraine's participation in EU programs and projects to support entrepreneurs, in particular in COSME (European Commission, 2024a) and EEN programs (European Commission, 2024c). In addition with the creation of a remote access platform to innovative and digital business tools with components of mutual learning and exchange of experience. Finalizing with the simplification and optimization of means of administrative regulation of business, implementation of digitization of permit and license procedures.

ICT Innovation Networking Activities play a crucial role in building Eastern Partnership (EaP) communities in selected ICT innovation policy areas. In addition to the creation of networks at the country level, bilateral and multilateral bridges should be established between organizations of the Eastern Partner Countries and EU stakeholders to ensure further sustainable joint activities and implementation of projects. The EU4Digital (2024) initiative of the European Union supports the program of digital reforms in Ukraine through a number of measures to promote key areas of the digital economy and society in accordance with EU norms and practices to ensure economic growth, create more jobs, improve people's lives and help businesses. Ukraine, in cooperation with the EU, launched a continuation of the project called EU4DigitalUA (2020-2024). The project is aimed at accelerating the process of digital transformation in Ukraine and focuses on five key tasks: functional compatibility and digital government infrastructure; institutional strengthening and capacity development; communication and public awareness; Development of electronic services; cybersecurity and data protection.

Also, the EU continues to support digital transformation in Ukraine through the Support for Digital Policy of Ukraine project (2021-2024). It contributes to Ukraine's fulfillment of the obligations of the Association Agreement between the EU and Ukraine and helps the Ministry of Digital Transformation of Ukraine and the telecom regulator to achieve policy goals in the field of the digital economy.

The ongoing EU-funded EaP Connect program also supports ICT innovation by connecting research and education communities across the region with their European counterparts via high-bandwidth broadband internet. It provides up to two million local scientists, students and researchers at more than 700 institutions with access to global research. EaP Connect recently doubled the Internet bandwidth for research data flows between Ukraine and Europe. The GÉANT ultra-secure, high-capacity Internet connection for research data

between Ukraine and the Pan-European Research and Education Network now offers double the bandwidth of the previous connection, but costs less than half the previous price per gigabit per second of transferred data (GÉANT, 2024).

Digital transformation is playing an increasingly important role in the economic recovery and implementation of reforms in Ukraine and the development of the national ecosystem of innovation, information and communication technologies and start-ups in Ukraine. Even during a full-scale war, Ukraine's information and communications technology (ICT) sector continues to show growth.

Attracting additional financial resources for technological progress in the reconstruction of Ukraine, as well as deepening international cooperation in the field of digital transformation in October 2023, was carried out to implement the provisions of Chapter V "Economic and industry cooperation" of the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their member states, on the other hand. Within the framework of the Agreement during 2024–2027, the European Commission proposed to create a new instrument “Mechanism for Ukraine” (Ukraine Facility) in the amount of 50 billion euros in the form of grants and loans to provide predictable financial support to Ukraine. As part of the Ukraine Facility, the Ukraine Aid Fund was established with the aim of restoring, reconstructing and modernizing our country. The fund will support structural reforms and investments aimed at increasing the growth potential of the Ukrainian economy, as well as contribute to deepening the integration of digital markets.

Ukraine's participation in the Digital Europe program allows domestic researchers to receive digital grant funding for technology projects with a total budget of 6 billion euros (European Commission, 2024d). As part of the program, domestic researchers will be able to receive funding for the development of their own projects, namely: high-performance computing, artificial intelligence, digital skills and the use of technology in the economy and society. Thanks to participation in the Digital Europe Program, a network of digital innovation hubs is being formed in Ukraine, which will help businesses test the necessary technologies and tools, as well as invest in the most effective ones.

As part of the European I4MS initiative, with the support of the cascade financing mechanism of the Horizon 2020 program, a digital innovation hub “Hub-laboratory Internet of Things: DIH I4MS Ukraine” was created in Ukraine (Agency of European Innovations, 2016). European Digital Innovation Hubs (EDIH) are core elements of the EU's innovation infrastructure to accelerate digital transformation and respond to digital challenges. The European network coverage, already consisting of 228 digital innovation hubs and one-stop centers, facilitates the exchange of best practices between centers around the world and the provision of specialized services in regions that are not available locally (European Commission, 2024b).

The EU-supported Digital Transformation for Ukraine (DT4UA) project improves the efficiency of public service delivery, ensures rapid response to war-related needs, and enhances day-to-day management capabilities (EU4Digital, 2023). This will also be facilitated by the

platform for effective dialogue between business and government, launched by the II International Export Forum “From the restoration of Ukraine to global economic prosperity,” which took place on October 24–25 of this year and was dedicated to economic recovery programs, as well as mechanisms to support exports and innovation.

In order to increase the stability of electronic communication networks and prevent their breaks in emergency situations, states of emergency and martial law communications. The adoption of this bill will stimulate the deployment of high-speed electronic communications networks, promote the stable operation of electronic communications networks and access to digital systems or systems that provide equivalent functionality.

The USAID project “Cybersecurity of Critical Infrastructure of Ukraine” and the Ministry of Digital Transformation of Ukraine are launching a grant program in the amount of $500 thousand. USA to finance innovative solutions and technology products in the field of cyber defense. This is a 4-year project aimed at strengthening Ukraine’s cyber readiness and cyber resilience through systemic reforms, building Ukraine’s human resources in the field of cybersecurity, and partnerships with the private sector.

In March 2023, the digital sustainability accelerator "Community 4.0" was launched in Ukraine, which will help create and implement digital transformation projects in Ukrainian regions. Communities that join the Digital Sustainability Accelerator will receive expert support in the digital transformation of their operations. In particular, thanks to the program, communities will be able to develop their own digital products ready for piloting. The program "Accelerator of Digital Sustainability Community 4.0" is implemented in Ukraine by the international organization "SocialBoost" with the support of the Ministry of Digital Transformation of Ukraine and the "U-LEAD with Europe" Program.

Conclusion

Digitization in Ukraine has evolved through several stages, starting with the introduction of information technologies in the 1990s. The transition to e-Government began in 2010, with the government and municipal bodies implementing electronic management systems, services, and portals to provide online access to public services. This period saw significant progress in the introduction of electronic government and digitalization of public services, such as the PROZORRO system, which ensures transparency, efficiency, and combats corruption in public procurement.

The "Diia" platform and mobile app were introduced in this stage, facilitating interaction between citizens and the state. It allows users to perform various administrative services and transactions online, avoiding queues and bureaucratic obstacles. The app also allows users to store and manage their electronic documentation, such as passports and driver's licenses.

Current digitization trends in Ukraine include online services becoming more accessible and widespread, AI implementation in business and public sectors, increasing productivity and improved services, and the implementation of IoT technologies in manufacturing, transportation, and healthcare. Initiatives for electronic voting and governance are also being

implemented, involving citizens in decision-making processes and ensuring transparency and legitimacy of power structures.

From 2020 to 2025, the Ukrainian government initiated and implemented several steps to transform itself, including identifying the state as the main player in the sector, legitimizing basic digital rights, implementing infrastructure projects, initiating digital transformation projects, creating conditions for over 300,000 new jobs in the digital economy, and implementing universal digital services for citizens.

In conclusion, Ukraine has experienced significant digitization, with the government transforming its internal administration, political life, and organization to build on innovative solutions.

The digital economy is expected to contribute 50-60% of the world's largest countries' GDP by 2030, with Ukraine potentially reaching 65% of this figure. The country has been working on developing artificial intelligence (AI) as part of its strategic initiative in Information and Communication Technology (ICT). The concept aims to integrate AI in nine domains, including education, science, economics, cybersecurity, information security, defense, public administration, legal regulation, and justice.

The development of AI in education will focus on training highly qualified specialists, stimulating scientific research, improving business climate, developing computing infrastructure, identifying and neutralizing information threats, and ensuring national interests. In defense, AI will be used in command-and-control systems, weapons and military equipment, combat operations, reconnaissance, countering cyber threats, and analyzing troop capabilities.

In public administration, AI technologies will be used for digital identification, personal verification, healthcare, and analyzing performance indicators. Legal regulation will integrate European standards into Ukrainian legislation, improving legal assistance to Ukrainians. Justice will also benefit from AI development.

Ukraine has been a pro-European asset, joining the European Open Science Cloud Council (EOSC) in 2020. This initiative aims to create a pan-European Digital Platform to support open science and research. The Ministry of Economic Development, Trade, and Agriculture of Ukraine's strategic activity plan for 2022-2024 includes creating an online platform for small and medium-sized businesses, establishing a national network of 24 innovative business incubators, expanding participation in EU programs, and simplifying administrative regulations.

ICT Innovation Networking Activities are crucial for building Eastern Partnership (EaP) communities in selected ICT innovation policy areas. Bilateral and multilateral bridges should be established between organizations of Eastern Partner Countries and EU stakeholders to ensure sustainable joint activities and implementation of projects. The EU4Digital (2024) initiative supports digital reforms in Ukraine through measures promoting key areas of the digital economy and society in accordance with EU norms and practices. Ukraine has launched a continuation of the EU4DigitalUA project (2020-2024), aiming at accelerating the process of digital transformation in Ukraine.

The EU continues to support digital transformation in Ukraine through the Support for Digital Policy of Ukraine project (2021-2024). The ongoing EU-funded EaP Connect program connects research and education communities across the region with their European counterparts via high-bandwidth broadband internet, providing up to two million local scientists, students, and researchers at more than 700 institutions with access to global research.

Digital transformation is playing an increasingly important role in the economic recovery and implementation of reforms in Ukraine and the development of the national ecosystem of innovation, information and communication technologies, and start-ups. Ukraine's participation in the Digital Europe program allows domestic researchers to receive digital grant funding for technology projects with a total budget of 6 billion euros.

Digitization in Ukraine continues to actively develop, creating new opportunities for economic growth. However, there are challenges such as cybersecurity and internet accessibility that need attention and solutions to achieve the full potential of digital transformation in Ukraine.

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