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ADVANCING EUROPEAN DIGITAL ECONOMIC INTEGRATION IN THE CONTEXT OF UKRAINE'S POST-WAR RECOVERY

Abstract

The article examines Ukraine's prospects for digital economic integration with the European Union in the context of postwar recovery. The study employs a methodology that combines comparative, content, and scenario analyses with elements of strategic planning. The findings demonstrate that digital transformation is a key driver of sustainable development, economic security, and accelerated modernization in Ukraine. A comprehensive comparison of Ukraine's and EU countries' digital trajectories was carried out for the first time, using DESI indicators to reveal areas for synchronization and structural gaps. Content analysis of strategic documents was used to identify three conceptual approaches to integration: harmonization, functional, and scenario. For the first time, the author develops an indicative model of digital integration adapted to the post-war context, comprising the stages of technical stabilization, functional adaptation, and deep integration. Additionally, a functional interpretation of digital sovereignty as a component of economic security is proposed.

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Problem Statement

In the current geopolitical environment, digitalization has become a vital tool for economic development and an essential component of national security, crisis resilience, and institutional modernization. For Ukraine, which is in the midst of large-scale post-war recovery, digital transformation and integration into the common European digital space are essential to achieving both short-term stabilization and long-term development. As the digital economy increasingly becomes the dominant factor in global competition, synchronizing Ukraine's strategies with EU digital initiatives, such as the Digital Decade Policy Program 2030, Digital Compass, and Horizon Europe, is a relevant issue that warrants systematic scientific reflection.

This study is of particular significance in the postwar era, when the restoration of digital infrastructure, public e-services, digital financial platforms, and innovative business models is not only essential but also serves as the foundation for a comprehensive economic revitalization. In this context, European digital economic integration is regarded as a catalyst for Ukraine's modernization, facilitating market access, investment opportunities, and the adoption of novel technologies. Additionally, it is perceived as a mechanism for shaping digital sovereignty, a factor deemed paramount to the economic security of the state.

The purpose of this article is to identify opportunities, barriers, and prospects for Ukraine's digital economic integration with the European Union in the

context of post-war recovery, and to develop an indicative model of integration that takes into account the specifics of post-conflict transformation.

To this end, the **following tasks** must be addressed:

- to conduct a comparative analysis of digital indicators of Ukraine and the EU countries;
- to identify conceptual approaches to the integration of digital strategies of the EU and Ukraine;
- to form an indicative model of digital integration, taking into account the challenges of the post-war period;
- to identify functional aspects of digital sovereignty as a component of Ukraine's economic security;
- to assess potential scenarios for deepening Ukraine's digital integration within the framework of the formation of a common European digital market.

The relevance of this study stems from the need to develop effective mechanisms for digital policy in the context of armed conflict and the necessity of strategic planning for post-war reconstruction based on advanced European practices and technologies. The proposed approach enables both the delineation of a theoretical framework for digital integration and the formulation of practical recommendations for the development of a comprehensive digital policy in Ukraine within the European context.

Literature Review

A range of sources was analyzed for this article, including strategic documents from both the European Union and Ukraine, as well as scientific publications. This approach ensured comprehensive coverage of the topic of digital integration in the context of Ukraine's post-war recovery.

The analysis of foreign documents, in particular the Digital Decade Policy Program 2030 (European Parliament and the Council of the European Union, 2022), the Digital Compass (European Commission, 2021), the EU eGovernment Action Plan 2016-2020 (European Commission, 2016), and Horizon Europe (European Commission, n.d.), has enabled the identification of key priorities for digital transformation in the EU, including digital skills, infrastructure, electronic public services, and support for digital business and innovation. These documents laid the groundwork for establishing the content analysis framework for the European digital strategy, thereby enabling the formulation of a conceptual vision for approaches to Ukraine's digital integration into the European space. Importantly,

these strategies not only outline the EU's internal objectives but also envision openness to collaboration with partner states, building a foundation for Ukraine's participation in joint initiatives. Thus, these sources provided the basis for developing an indicative model of integration adapted to the circumstances of post-war recovery.

The review of Ukraine's national documentation, including the Concept for the Development of the Digital Economy and Society of Ukraine for 2018-2020 (Cabinet of Ministers of Ukraine, 2018), the digital strategy Diia.Digital State (Ministry of Digital Transformation of Ukraine, n.d.), and the provisions of the National Recovery Plan for Ukraine for 2024-2027 (Cabinet of Ministers of Ukraine, 2024), has enabled an examination of the internal potential and progress of digital transformation in Ukraine. It has been confirmed that Ukraine has already taken significant steps towards the digitalization of public services, access to electronic services, and the development of digital infrastructure. Concurrently, the analysis of these sources revealed a certain fragmentation in the implementation of nationwide digital standards, limited coordination with European initiatives, and the lack of a sustainable digital security system. This situation underscores the urgency of enhancing digital sovereignty. These national strategies have become the basis for formulating the functional aspects of digital sovereignty as a key component of the state's economic security.

Additionally, a comprehensive review of scientific publications from the Scopus database was conducted, shedding light on various facets of digital transformation in public administration, international economics, and security. In particular, Ivanov and Dolgui (2020) emphasize the concept of digital twinning for risk management in supply chains. Mergel et al. (2019) analyze expert approaches to defining digital transformation, and Wirtz et al. (2019) explore the application of artificial intelligence in the public sector.

Shevchenko et al. (2023) analyze global experiences in the formation and development of the digital economy, focusing on the key concepts, structural elements, and directions of digital transformation. Using the Network Readiness Index, the authors conduct a comparative analysis of countries to identify leaders in digital development and determine the success factors of digital strategies. Particular attention is given to the challenges faced by countries with transformational economies, such as the need to improve the regulatory environment, develop digital infrastructure, and enhance digital competencies. This work significantly contributes to our understanding of global trends in the digital economy and establishes the foundation for future research in this field.

Despite the merits of these works, which include their high quality and extensive analytical foundation, they generally fail to consider the particularities of countries with experience of armed conflict or those in the process of post-war recovery. The concept of digital sovereignty as a comprehensive component of the economic security system has also received limited attention. Furthermore, exist-

ing studies have yet to provide a comprehensive comparison of the digital trajectories of Ukraine and the EU in the format of an integration model, which constitutes the key scientific novelty of this article.

Consequently, the examined sources established the foundation for formulating the primary conclusions and facilitated the identification of a scientific niche: a systematic study of Ukraine's digital integration in the context of post-conflict recovery, considering security, economic, and institutional factors.

Methodology

The methodological foundation of the study is predicated on an interdisciplinary approach that integrates economic, political, and institutional analysis, with a consideration of the context of Ukraine's post-war recovery. To achieve the research objectives, a set of methods was used, each of which performed a specific function in the analytical process.

Firstly, a comparative analysis was employed to compare Ukraine's digital indicators with those of the European Union (in particular, the data from the Digital Economy and Society Index, DESI). This made it possible to reveal fundamental structural disparities and the level of Ukraine's digital maturity, as well as to identify the opportunities and constraints affecting Ukraine's integration into the European digital space. The application of this method ensured an objective assessment of Ukraine's position relative to the EU's top digital performers (e.g., Denmark) and the EU average.

Secondly, a content analysis was conducted on the strategic documents on digital development of the EU (such as the Digital Compass, the Digital Decade Policy Program 2030, and Horizon Europe) and Ukraine (Concept of Digital Economy Development, Diia.Digital State, National Recovery Plan). This methodological approach helped to discern shared objectives, the rationale for strategic planning, and the domains for regulatory convergence, as well as to establish a conceptual framework for developing the model of digital integration.

The third key method was scenario analysis, used to model possible trajectories of Ukraine's integration into the EU digital space while taking into account geopolitical, institutional, and resource factors. This method was instrumental in developing three conceptual approaches—the harmonization approach, the functional approach, and the scenario approach—which reflect the flexibility of the integration process in the context of post-conflict uncertainty.

Furthermore, to ensure the study's practical orientation, elements of strategic planning were applied, which were implemented in the form of an indicative model of digital integration. The model is based on a sequential approach com-

prising technical stabilization, functional adaptation, and deep integration. It is structured around five functional domains: institutional, infrastructural, economic, educational, humanitarian, and security.

The combination of these methods enabled a systematic evaluation of the prevailing digital policy landscape and the formulation of strategies for its transformation within the broader context of Ukraine's European integration trajectory. The methodology employed in this study is pertinent to the examination of digital transformation in post-conflict economies and can be adapted for application in other cases involving EU candidate countries.

Research Results

In the context of Ukraine's post-conflict recovery, it is imperative to assess the country's digital maturity level in comparison to the European Union. This approach enables the identification of both existing barriers and potential opportunities for integration into the European digital space. Digital transformation has emerged as a pivotal catalyst for economic growth, institutional modernization, and economic security. A comparative analysis of digital indicators, particularly in accordance with the Digital Economy and Society Index (DESI) methodology, offers an objective assessment of the current state of the digital economy and society in Ukraine and the EU.

Table 1

Comparison of digital indicators: Ukraine and EU countries (as of 2023)

Indicator	Ukraine	EU average	Denmark	Italy
Availability of basic digital skills among the population (16-74 years old)	~53%	55.5%	70%	45.8%
5G coverage among households	~30%	66%	98%	60%
Use of cloud technologies by enterprises	~20%	34%	62%	30%
Use of artificial intelligence by enterprises	~5%	8%	24%	8%
Integration of digital technologies in business (basic level)	~30%	55%	79%	40%
Use of electronic public services by the population	~60%	74%	90%	65%
Fixed broadband Internet coverage	~85%	90%	95%	88%

Source: compiled by the authors.

The analysis of digital indicators reveals that Ukraine exhibits a moderate level of digital maturity in comparison to EU countries. Specifically, the proportion of the Ukrainian population possessing fundamental digital skills is estimated to be approximately 53%, a figure that closely aligns with the EU average of 55.5%. However, in countries such as Denmark, this figure reaches 70%, while in Italy it is only 45.8%.

With regard to the adoption of 5G technology, Ukraine has a coverage rate of approximately 30% among households, which is considerably lower than the EU average of 66% and significantly behind Denmark, which has a coverage rate of 98%. Italy has 60% coverage.

With regard to the utilization of cloud technologies by enterprises, Ukraine exhibits a rate of approximately 20%, which is below the EU average of 34%. In Denmark, the figure reaches 62%, while in Italy it is 30%.

The utilization of artificial intelligence by enterprises in Ukraine stands at approximately 5%, which is marginally below the EU average of 8%. In Denmark, the figure stands at 24%, while in Italy it is 8%.

The integration of digital technologies in business in Ukraine at the basic level is approximately 30%, which is significantly lower than the EU average of 55%. In Denmark, the figure is 79%, while in Italy it is 40%.

The utilization of electronic public services by the population in Ukraine stands at approximately 60%, which is below the EU average of 74%. In Denmark, for instance, the figure is 90%, while in Italy it is 65%.

The percentage of Ukrainian households with access to fixed broadband Internet is approximately 85%, which is marginally below the EU average of 90%. In Denmark, the figure is 95%, and in Italy, it is 88%.

Ukraine's integration into the digital European space holds considerable economic potential and could serve as a catalyst for the country's transformation. The primary objective is to enhance the competitiveness of the Ukrainian economy by modernizing business models, providing access to EU digital markets, and attracting investments in technology sectors. Programs such as Horizon Europe, Digital Europe, and EU4Digital create opportunities for small and medium-sized businesses (SMEs) in Ukraine to receive financial support, technology transfer, and access to new markets.

Digital trade, which is undergoing rapid expansion in the European Union and thereby influencing the emerging structure of the global economy, merits particular consideration. For Ukraine, integration into the European digital market signifies a reduction in non-tariff barriers, mutual recognition of digital signatures, streamlined customs procedures, and the advancement of cross-border e-commerce. This dynamic has the potential to stimulate increased export flows, particularly within the high-tech sector, IT services, and creative industries.

Concurrently, the process of economic integration necessitates substantial investments in digital infrastructure, particularly in the context of de-occupied and rural regions, where there is a pronounced digital divide. Digital accessibility is a matter of both social and economic importance, impacting regional development and employment opportunities.

It is imperative to ensure sustainable digital financing, particularly through the development of the fintech ecosystem, smart contracts, blockchain solutions, and digital payment platforms. This will contribute to enhancing transparency, reducing transaction costs, and facilitating increased access to capital, particularly for innovative businesses.

Digital economic integration, therefore, signifies more than mere technical or institutional adaptation; it represents a profound economic transformation that will generate new growth points for Ukraine in the post-war period. The state's capacity to integrate digital transformation with industrial policy, entrepreneurship promotion, and comprehensive economic reforms will serve as pivotal factors in determining its success.

Despite the challenges it faces, Ukraine possesses considerable potential for digital integration with the European Union. The implementation of the Diia.Digital State initiative is a significant contributor to the development of electronic public services and the enhancement of digital literacy among the population. Moreover, engagement in EU initiatives such as Digital Compass and Horizon Europe facilitates the attraction of investment in digital infrastructure and innovation.

The enhancement of digital competencies among the populace, the augmentation of 5G coverage, and the integration of contemporary digital technologies within commercial enterprises represent pivotal domains for future expansion. This will enable Ukraine to achieve a level of integration with the EU that is corresponding with its average performance, thereby fostering its competitiveness in the digital economy.

This study examined the strategic documents related to the European Union's digital development (in particular the Digital Decade Policy Program 2030, the Digital Compass, the eGovernment Action Plan, and Horizon Europe) and the strategic framework of Ukraine (the Concept of Digital Economy Development, the Action.Digital State, and digitalization within the National Recovery Plan). These documents reveal shared objectives and orientations between the European Union and Ukraine (see Table 2), creating favorable conditions for integration. Collaboration in the field of digitalization has the potential to facilitate Ukraine's effective post-war recovery and integration into the European digital landscape.

Table 2

Comparative analysis of digital strategies of the EU and Ukraine

Document / Program	Goals and Priorities	Key directions	Potential for integration
Digital Decade Policy Programme 2030	Achieving the EU's digital transformation by 2030	Digital skills Digital infrastructure Digitalization of business Digital public services	Establishing common goals and mechanisms of cooperation between the EU and Ukraine
Digital Compass	Identifying four key areas of digital development	Skills-Infrastructure Business Public Services	Facilitating the harmonization of strategies and exchange of best practices
eGovernment Action Plan	Modernizing digital public services in the EU	Unified digital portal Interoperability of registries «One time» principle	Improving the efficiency and transparency of public services in Ukraine
Horizon Europe	Supporting research and innovation in the EU	Digital technologies Innovations Scientific research	Opportunity for Ukrainian researchers and enterprises to participate in joint projects
Concept for the development of Ukraine's digital economy	Creating an enabling environment for the digital economy	Development of digital infrastructures Support for innovation Development of digital skills	Alignment with European standards and practices
Diia.Digital state	Ensuring access to digital public services	Diia mobile application Electronic documents Online services	Integration with European digital platforms and services
Digitalization as part of the National Recovery Plan	Rebuilding and modernizing digital infrastructure	Broadband development Support for digital startups Digital skills development	Promoting economic growth and social inclusion through digital technologies

Source: made by the author.

Based on the findings of the content analysis, three key conceptual approaches to integrating the EU and Ukraine's digital strategies were identified.

1. Harmonization approach. This process entails the incremental alignment of Ukrainian digital legislation, standards, and technical regulations with European norms, particularly those related to:

- implementation of the GDPR principles;
- unification of digital identification and cybersecurity standards;
- joining the European digital platforms (EU eID, Digital Single Gateway).

2. Functional approach. Aimed at integration through joint projects, programs, and platforms, without full legal approximation:

- participation in the EU4Digital, Horizon Europe, Connecting Europe Facility programs;
- digital interoperability of state registries and data exchange platforms;
- transnational digital hubs and R&D networks.

3. Scenario approach. It involves the formation of flexible scenarios for digital integration, taking into account:

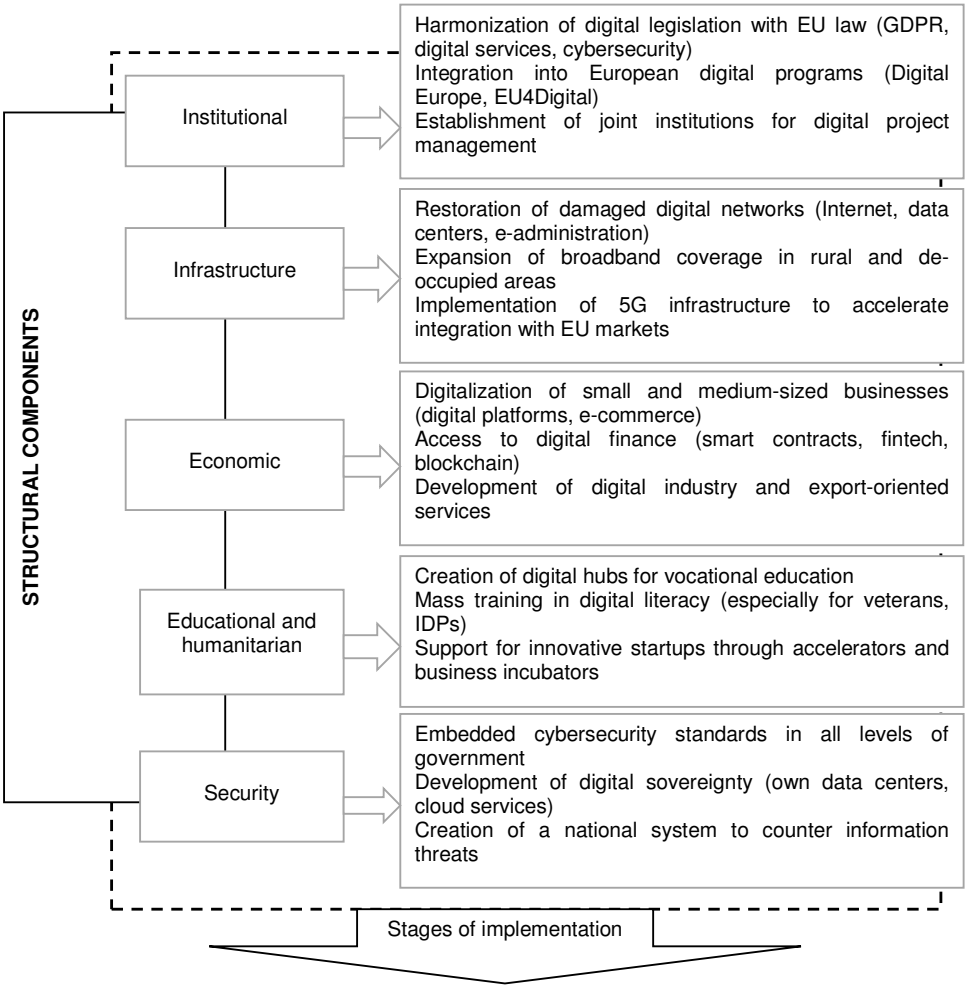
- features of post-war reconstruction;
- security priorities;
- resource constraints and potential for international support.

Thus, the generalization of European and national strategic documents, as well as the definition of three conceptual approaches — harmonization, functional, and scenario — allow us to proceed to the development of an applied digital integration framework. In light of the unique characteristics of the post-war period, marked by the imperative for swift recovery in conjunction with the necessity for strategic transformation, the objective is to formulate a flexible, phased, and adaptive integration model. Such a model must consider both Ukraine's institutional capabilities and the key European vectors of digital development. It should act as a tool for strengthening economic resilience, digital sovereignty, and technological modernization.

In this regard, we propose an indicative model of Ukraine's digital integration (Figure 1), which is adapted to the conditions of post-conflict recovery and meets current security, economic, and infrastructure challenges.

Figure 1

An indicative model of digital integration for Ukraine in the post-war recovery



Stage	Name	Duration	Key actions
I	Technical stabilization	6–12 months	Infrastructure restoration, regulatory framework
II	Functional adaptation	1–2 years	Digitalization of key industries, start of integration with the EU
III	Deep integration	3–5 years	Full compatibility with the European digital market

Source: authors' own elaboration.

As illustrated in Figure 1, the proposed indicative model of digital integration for Ukraine in the context of post-conflict recovery involves a phased process that includes technical stabilization, functional adaptation, and deep integration with the EU digital space. The scientific novelty of the model lies in its adaptability to post-conflict conditions, as well as in the combination of regulatory, infrastructural, and institutional approaches within a single structured system. Notably, this model integrates the stages of digital development with specific objectives and integration mechanisms, thereby enabling the strategic planning of Ukraine's digital policy within the broader context of the EU's economic space. To further explore this relationship, a more comprehensive comparison of the digital trajectories of Ukraine and the European Union is necessary. Such a comparison would allow for the identification of both synchronized elements and structural differences in their digital approaches.

This study is pioneering in its comprehensive comparison of the digital trajectories of Ukraine and the European Union, taking into account the following:

- strategic goals of digital development (e.g., Digital Decade 2030 for the EU and Digital Transformation of Ukraine 2020-2030);
- indicators of digital maturity (DESI – Digital Economy and Society Index for EU countries; digital indices formed by the Ministry of Digital Transformation for Ukraine);
- specialized digital policies, including the development of e-government, cybersecurity, digital education, open data, e-commerce;
- institutional compatibility and the potential for legal harmonization under the EU-Ukraine Association Agreement.

A comparative analysis of the key parameters of Ukraine's and the EU's digital trajectories was conducted to identify the levels of digital development and potential for integration into the EU's digital single market. Table 3 demonstrates both the common features of the strategies and the existing gaps in the development of digital policy, which are crucial for the formation of an effective integration model.

The results of the study showed that Ukraine has already implemented some of the principles of digital European integration (for example, through the Diia system), but needs deeper institutional coordination and investment in sustainable digital infrastructure.

Table 3

Comparative characterization of digital trajectories of Ukraine and the EU

Criteria	European Union (EU)	Ukraine	Comment / Level of compliance
Digital Strategy	*Digital Decade 2030 – clear goals, digital sovereignty, ethical standards*	*Digital Transformation of Ukraine 2020-2030, Diia project*	The directions are the same, but the level of resources is different
Digital governance	High level of e-services, GDPR, digital identity	Electronic services through Diia, expansion of e-services, lack of full synchronization with GDPR	High integration potential, requires harmonization
Cybersecurity	Single policy, ENISA, EU cybershield	Law on Cybersecurity, Cyber Defense Center, partnership with NATO	Partial compatibility, insufficient institutional coordination
Digital infrastructure	Deployed 5G, data centers, green digital infrastructure	Broadband Internet in the process of restoration, 5G in the process of launch	High asymmetry, potential for EU support
Inclusion and digital education	Digital skills strategy, support through Erasmus+, EU Code Week	Programs of the Ministry of Digital Transformation, Diia.Digital Education, national digital inclusion projects	High relevance in terms of content, but lower scale
Digital economy and business	Digital entrepreneurship platforms, support for innovation (EIC, Horizon Europe)	Startups, eResidence, grant programs, Diia.City	Partial compliance, needs to strengthen investment support

Source: authors' own elaboration.

Conclusions

The study demonstrates that Ukraine's integration into the European digital space is not only appropriate, but critically necessary in the context of post-war recovery. A comparative analysis of digital indicators reveals that Ukraine lags behind in several areas, including 5G coverage, business digitalization, cloud technology utilization, and artificial intelligence. However, the analysis also indicates significant potential for future growth in these sectors. A comparative content analysis of the strategic digital documents of the EU and Ukraine enabled the identification of common goals, synchronized development directions, and integration mechanisms. The indicative model of Ukraine's digital integration is proposed, which is adapted to challenges of post-war recovery and includes three stages: technical stabilization, functional adaptation, and deep integration. The functional aspects of digital sovereignty as a key component of the economic security of the state are also highlighted.

The findings of this study provided the foundation for a set of recommendations regarding public policy and digital transformation management in the context of Ukraine's post-war recovery. First and foremost, there is an urgent necessity to enhance institutional coordination between national digital initiatives and European programs, including Digital Europe, Horizon Europe, and EU4Digital. This will help ensure the coordination of strategic planning, prevent duplication of functions, and improve the efficiency of integration processes.

A critical component of management decisions should be the adoption of the harmonization approach to regulatory approximation with EU digital law. This includes adapting regulations pertaining to personal data protection (GDPR), cybersecurity, and digital identity. These measures will establish conditions conducive to the secure operation of the digital market and the reduction of legal impediments to interaction with European partners.

A particularly promising area of research is the development and implementation of a national program to stimulate the use of cloud services, artificial intelligence, and innovative IT solutions in business. This strategic initiative is aimed at enhancing the digital competitiveness of Ukrainian enterprises, bridging the technological gap, and facilitating integration into European digital value chains.

It is imperative to prioritize sustainable investment in digital infrastructure, particularly in underdeveloped and rural regions. This initiative will contribute to economic recovery and reduce the digital divide between regions, which is of strategic importance for social cohesion and political stability. Furthermore, the introduction of systemic support for digital education and digital inclusion is imperative, with a particular emphasis on vulnerable groups such as veterans, displaced per-

sons, and residents of remote communities. These measures will play a pivotal role in the development of a digital culture, which will, in turn, serve as the foundation for building an inclusive and innovative society.

In the context of further research, it is recommended that an in-depth empirical assessment be conducted to evaluate the digital risks and vulnerabilities facing the Ukrainian economy during the recovery. Furthermore, the development of digital security assessment models adapted to the post-conflict context is imperative. These models should account for both institutional risks and technological threats.

A promising area of research is the study of scenarios for the development of Ukraine's digital sovereignty, in particular in the format of associate membership in the EU's digital single market. This approach will allow for the assessment of not only the legal and technological aspects of integration, but also the institutional sustainability of the Ukrainian digital system. In the same vein, it is important to assess the efficacy of digital transformation pilot initiatives, such as Diia.City or eResidency, in terms of their impact on the domestic digital ecosystem and their scalability within the broader digital space with the EU.

Finally, an interdisciplinary examination of the impacts of digital transformation on social inclusion, regional development, and spatial equity in the post-war reconstruction era will deepen our understanding of the role of digital policy in shaping the new architecture of Ukraine's socio-economic sustainability.

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