CHAPTER
INNOVATIVE ECONOMY AS A FOUNDATION FOR SUSTAINABLE DEVELOPMENT IN THE CONTEXT OF DIGITALIZATION AND POST-WAR TRANSFORMATION

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Summary

The article examines the theoretical and methodological foundations of the formation and development of an innovative economy in the context of digital transformation, wartime challenges, and post-war recovery. The essence of the innovative economy is revealed as a complex system that integrates technological, institutional, and socio-economic components and ensures the achievement of sustainable development goals. The role of digital transformation as a key factor of innovative development is substantiated, as it contributes to the integration of economic processes, enhances management efficiency, and facilitates the formation of new business models. The transformation of the institutional environment and mechanisms of state regulation under martial law conditions is analyzed, and their impact on the development of entrepreneurship and innovation activity is determined. The current state of Ukraine's innovative economy is assessed, while the main trends and structural changes caused by wartime factors are identified. The growing role of high-tech sectors and digital technologies as drivers of economic resilience is demonstrated. An integration model for the development of the innovative economy is proposed, ensuring the interaction of key elements of the economic system and contributing to the formation of an effective post-war recovery model focused on innovation, technological modernization, and long-term economic growth.

Introduction

The modern development of economic systems takes place under conditions of profound transformations driven by digitalization, globalization processes, and the necessity to achieve sustainable development goals. Under these conditions, the innovative economy is being formed as a leading development model based on the use of knowledge, information, and technologies as key factors for creating added value and ensuring long-term economic growth.

At the same time, transformation processes become particularly complex in countries operating under crisis challenges, especially in the context of military conflicts. For Ukraine, the full-scale war has become a factor that has significantly changed the structure of the economy, disrupted production and logistics chains, and reduced investment activity. However, alongside its destructive consequences, the war also acts as a catalyst for structural changes, stimulating the search for new approaches to the organization of economic activity and increasing its resilience.

In this context, digital transformation acquires crucial importance, as it ensures the adaptation of economic processes to conditions of uncertainty and serves as the foundation for the formation of an innovative economy. The implementation of digital technologies contributes to the integration of economic processes, the development of new business models, and the improvement of management efficiency, which is particularly important under conditions of limited access to traditional infrastructure.

At the same time, the effectiveness of innovative development largely depends on the quality of the institutional environment, which creates the conditions for the realization of the innovative potential of the economy. Under modern conditions, institutional mechanisms are being transformed toward digitalization, increased flexibility, and adaptability to external challenges, which contributes to the development of entrepreneurship, the reduction of administrative barriers, and the attraction of investments.

These processes acquire particular importance in the context of post-war recovery, which involves not only the reconstruction of the economy but also its technological modernization. In this regard, the innovative economy is considered the foundation for the formation of a new development model focused on digitalization, efficient resource utilization, and ensuring the long-term resilience of the economic system.

The study of the innovative economy in the context of digital transformation, wartime challenges, and post-war recovery makes it possible to identify the key factors of its development, substantiate the strategic directions of economic transformation, and form an effective model for its functioning under modern global and national challenges.

1. Theoretical foundations of the formation of an innovative economy and sustainable development under conditions of modern transformations

The current stage of the development of economic systems is characterized by profound transformational processes caused by digitalization, globalization, and the intensification of environmental challenges. Under these conditions, the innovative economy acts as a basic model of development that ensures increased efficiency in the use of resources, the formation of new markets, and

the growth of the competitiveness of national economies. Unlike traditional economic models, the innovative economy is based on the systematic use of knowledge, information, and technologies as key factors of production, which leads to changes in the structure of the economy and strengthens the role of intangible assets.

In modern Ukrainian research, the innovative economy is considered a complex multi-level system that integrates research activity, entrepreneurship, the institutional environment, and digital technologies. The development of the innovative economy is associated with the formation of a national innovation system that ensures interaction between the state, business, and scientific institutions, and also promotes the effective transfer of knowledge and technologies. At the same time, modern approaches to innovative development emphasize the necessity of digital transformation of the economy, which creates the preconditions for the formation of new business models and increased labor productivity [15].

An important aspect of the study of the innovative economy is its relationship with the concept of sustainable development, which under modern global challenges acquires strategic importance. Sustainable development is considered an integrated model that involves achieving a balance between economic growth, social development, and environmental security. Ensuring sustainable development requires a transition to an innovative economic model that makes it possible to increase the efficiency of resource utilization and minimize negative environmental impact [2].

The essence of sustainable development in modern economic science is revealed through the interaction of three key components: economic, social, and environmental. The economic dimension involves ensuring stable growth and increasing the efficiency of economic activity; the social dimension is aimed at improving the quality of life of the population, developing human capital, and reducing social inequality; the environmental dimension is focused on preserving the natural environment and ensuring the rational use of resources. In this context, innovations act as a universal tool for achieving a balance between these components, since they make it possible to simultaneously increase economic efficiency and environmental security.

Under modern conditions, the concept of sustainable innovations acquires particular importance, as they are aimed at creating new technologies and solutions with minimal negative environmental impact. Ukrainian researchers emphasize that the implementation of such innovations is a key factor in the transition to a “green” economy, which involves reducing emissions, increasing energy efficiency, and developing renewable energy sources. In this regard, the innovative economy acts not only as an instrument of economic growth but also as a means of achieving environmental balance.

At the same time, the concept of the circular economy is being actively developed, which involves the formation of closed cycles of resource utilization, making it possible to minimize waste and increase production efficiency. In modern Ukrainian research, it is emphasized that the circular economy is a logical continuation of the innovative development model, since it is based on the use of advanced technologies in the fields of recycling, reuse of materials, and waste management.

An important component of the innovative economy is human capital, which determines the ability of society to create and implement innovations. Under modern conditions, the role of education, science, and digital competencies is increasing as key factors of innovative development. Investments in human capital are a strategic priority, as they ensure the formation of innovative potential and enhance the competitiveness of the economy [2].

In addition, the innovative economy is characterized by the active implementation of digital technologies, which act as a catalyst for transformational processes in various sectors of the economy. Digitalization contributes to the optimization of business processes, the improvement of management efficiency, and the creation of new forms of economic interaction. Modern studies emphasize that digital transformation is an integral component of innovative development and an important factor in ensuring the sustainability of economic systems.

The study of the innovative economy acquires particular importance under the conditions of the transformation of Ukraine's economic system caused by military actions and the necessity of post-war recovery. The full-scale war became a powerful shock to the national economy, leading to the destruction of production infrastructure, disruption of logistics chains, decline in investment activity, and significant losses of human capital. At the same time, these processes created the preconditions for the formation of a new model of economic development based on the principles of innovation, resilience, and adaptability.

Modern scientific approaches are shaping the concept of the "recovery economy", which is considered a specific type of transformational economic system focused on infrastructure reconstruction, production modernization, and the integration of innovative technologies into economic development processes. Unlike traditional recovery models, the modern reconstruction economy involves not merely restoring lost capacities, but their qualitative renewal based on digital solutions, "green" technologies, and innovative management approaches.

In this context, the innovative economy is transformed into the so-called "resilient economy", which is characterized by the ability to rapidly adapt to external shocks, recover after crisis phenomena, and ensure sustainable development under conditions of uncertainty. The key characteristics of such

an economy are flexibility, digitalization, diversification of the economic structure, and a high level of innovative activity.

Under conditions of martial law, the development of digital technologies acquires particular importance as an instrument for ensuring the continuity of economic processes. Digitalization makes it possible to maintain the functioning of businesses, state institutions, and the financial system even under conditions of limited access to physical infrastructure. The Ukrainian experience in the development of digital public services, e-governance, and financial technologies demonstrates a high level of adaptability of the economic system and its ability to undergo rapid transformation [6].

At the same time, the war has intensified the issue of structural restructuring of the economy, which involves reducing dependence on traditional industries and developing high-tech sectors. In this context, the innovative economy acts as a key direction of post-war recovery, since it makes it possible to ensure not only economic growth but also an increase in the resilience of the economic system to future crisis challenges.

A special role in the formation of a new economic model is played by the concept of "build back better", which involves economic recovery based on modern technologies, environmental standards, and innovative solutions. Within this concept, infrastructure reconstruction should be carried out in accordance with the principles of energy efficiency, digitalization, and sustainable development, which makes it possible to form a more competitive and efficient economy.

An equally important aspect is the integration of Ukraine into the European economic space, which acts as a key factor in the modernization of the national economy. Participation in European programs, harmonization of legislation, and implementation of European standards contribute to increasing the level of innovation within the economy and create the preconditions for attracting investments into recovery processes.

Under modern conditions, the role of human capital as the main resource of innovative development is significantly increasing. The war has caused substantial migration processes that affect the structure of the labor market and the availability of qualified personnel. At the same time, this stimulates the development of new forms of employment, particularly remote work, digital entrepreneurship, and the global integration of labor resources [2].

Thus, the current stage of the development of Ukraine's innovative economy is characterized by a transition to a new economic model that combines elements of digital transformation, sustainable development, and post-war recovery. Such a model is based on innovation as a key factor of economic growth, ensures increased economic resilience, and creates the preconditions for its long-term development.

2. Digital transformation as a system-forming gactor in the development of the innovative economy

The current stage of the development of the innovative economy is characterized by the active implementation of digital technologies that determine a new logic for the functioning of economic systems, transform business processes, and create new sources of competitive advantages. Digital transformation acts as a system-forming factor of innovative development, as it ensures the integration of technological, economic, and social processes within a unified digital ecosystem.

In modern Ukrainian research, digitalization is considered a comprehensive process of implementing digital technologies in all spheres of economic activity, which contributes to increasing labor productivity, optimizing managerial decision-making, and developing innovative entrepreneurship. At the same time, digital transformation is a key prerequisite for the transition to the data economy, in which information acts as a strategic resource and the basis for creating added value.

Particular importance is attached to the use of technologies such as artificial intelligence, Big Data, the Internet of Things (IoT), cloud and platform solutions, which ensure a qualitatively new level of functioning of economic systems. Their impact is manifested in increasing production efficiency, developing new business models, and creating conditions for integrating innovative activity into sustainable development processes [3].

In order to systematize the impact of digital technologies on the innovative and sustainable development of the economy, it is advisable to generalize their functional role in Table 1.

As can be seen from the table, digital technologies have a comprehensive impact on both innovative development and ensuring the sustainability of economic systems. Their use contributes to the formation of new economic relations, increasing management efficiency, and optimizing resource utilization.

An important aspect of the study of digital transformation is the assessment of the level of digital development of the economy. For this purpose, international indices are used, including DESI (Digital Economy and Society Index), NRI (Network Readiness Index), and EGDI (E-Government Development Index), which make it possible to conduct a comparative analysis of the level of digitalization in different countries [17].

As evidenced by the presented data, Ukraine demonstrates a stable positive dynamic in the development of e-governance, which confirms the intensification of digital transformation processes. The growth of the EGDI value is обусловлено by the development of digital infrastructure, the implementation of electronic public services, and the improvement of the population’s digital competencies.

Table 1

The impact of digital technologies on the innovative and sustainable development of the economy

Digital Technology	Essential Characteristics	Impact on Innovative Development	Impact on Sustainable Development
Artificial Intelligence	Automation of processes, intelligent data analysis	Increasing productivity, development of innovative products	Optimization of resource utilization, reduction of energy consumption
Big Data	Processing of large volumes of information	Support for managerial decision-making, development of analytics	Reduction of risks, increasing the efficiency of resource utilization
Internet of Things	Integration of physical objects into digital systems	Innovations in production, development of smart solutions	Increasing energy efficiency
Platform Technologies	Digital interaction platforms	Formation of new business models	Expansion of access to services
Cloud Technologies	Remote use of computing resources	Cost reduction, business scalability	Rationalization of resource utilization

Source: compiled by the author based on [3]

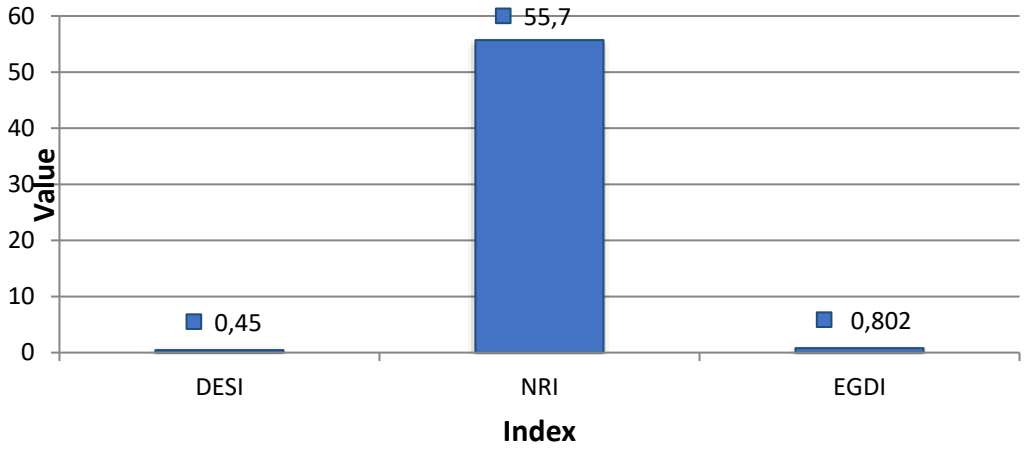

Figure 1. Assessment of the level of digital development of Ukraine according to key international indices

Source: United Nations, E-Government Survey [17]

Digital transformation also plays an important role in achieving sustainable development goals, as it contributes to increasing energy efficiency, optimizing resource utilization, and reducing environmental pressure. In particular, the implementation of digital technologies in the fields of energy, transport, and

industry makes it possible to reduce resource consumption and decrease greenhouse gas emissions.

At the same time, digitalization is accompanied by a number of challenges, among which the issues of cybersecurity, unequal access to digital technologies, and the insufficient level of digital literacy of the population acquire particular importance. In this context, ensuring effective digital transformation requires a comprehensive approach that includes the development of the institutional environment, improvement of the regulatory and legal framework, and intensification of investments in digital infrastructure.

Digital transformation acts as a key factor in the development of the innovative economy, ensuring the integration of technological innovations into sustainable development processes. Its impact is manifested in increasing the efficiency of economic systems, forming new business models, and creating conditions for long-term balanced development [11].

In order to generalize the relationship between digital transformation, innovative development, and sustainable development, it is advisable to present a conceptual model reflecting the systemic interaction of these elements Fig. 2.

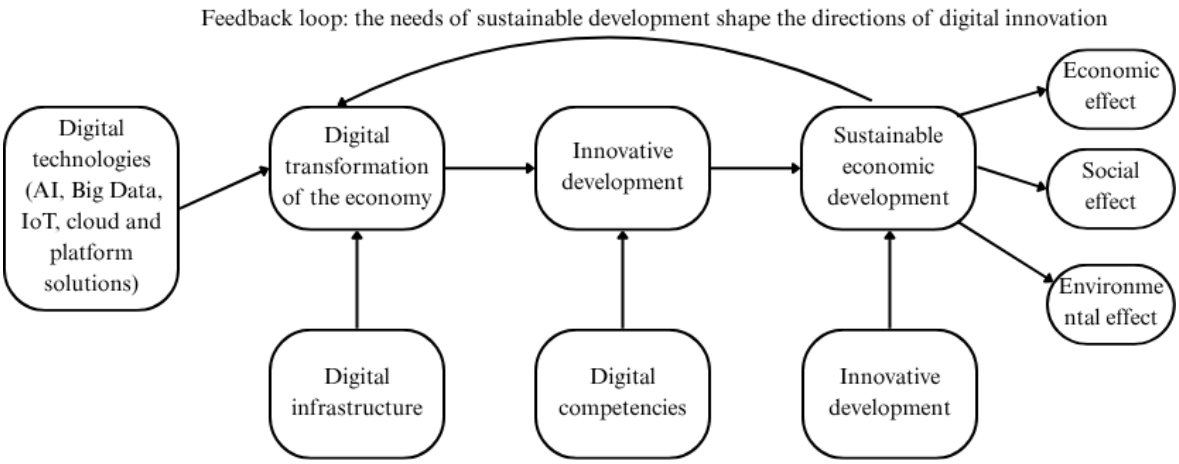

Figure 2. Conceptual model of the impact of digital transformation on innovative and sustainable development

Source: compiled by the author based on [3; 11]

As reflected in Fig. 2. digital technologies (artificial intelligence, Big Data, the Internet of Things, cloud and platform solutions) act as the foundation of the digital transformation of the economy. In turn, digital transformation ensures the formation of innovative development, which is manifested in the creation of new products, services, and business models, as well as in increasing the efficiency of economic activity.

An important component of the proposed model is the presence of feedback, according to which the needs of sustainable development create new requirements for digital technologies and innovative solutions. This ensures the continuity of the economic transformation process and its adaptation to modern challenges.

The effectiveness of the implementation of digital transformation depends on the development of digital infrastructure, the level of digital competencies of the population, and the quality of the institutional environment, which creates the necessary conditions for the integration of innovations into sustainable development processes [16].

The proposed conceptual model reflects the comprehensive nature of digital transformation and its determining role in the formation of the innovative economy and ensuring sustainable development.

Under conditions of modern transformations, the study of digital transformation in the context of wartime challenges, which significantly affect the structure and functioning of the national economy, acquires particular importance. The full-scale war in Ukraine has become a powerful catalyst for digitalization, accelerating the processes of implementing information and communication technologies in all spheres of economic activity. As noted in contemporary scientific research, digital transformation under wartime conditions acts not only as a factor in increasing the efficiency of economic processes, but also as a key instrument for ensuring their continuity and adaptability [15].

The war has significantly changed the nature of digital transformation, transforming it from a long-term strategic direction of development into a necessary condition for the functioning of the economy. In this context, digital technologies provide the possibility of remote management of business processes, support financial stability, ensure the functioning of state institutions, and facilitate communication between economic entities. Studies show that digitalization has become one of the key factors in preserving economic activity under conditions of limited access to physical infrastructure.

Particular importance is attached to the development of digital public services, which ensure the effective functioning of the public administration system. The Ukrainian experience in implementing digital platforms, particularly Diia, demonstrates a high level of the state’s adaptability to crisis conditions and its ability to provide administrative services in digital format. According to the Ministry of Digital Transformation of Ukraine, digital services have become an important instrument for supporting citizens and businesses during the war [18].

At the same time, digitalization contributes to the development of new forms of labor organization, particularly remote employment, which makes it possible to preserve the country’s labor potential even under conditions of mass

population displacement. Scientific studies emphasize that the development of the digital economy contributes to the formation of more flexible employment models and the integration of the national labor market into global economic processes.

An important direction of digital transformation is the development of financial technologies, which ensure the stability of the financial system and the continuity of payment operations. During the period of martial law, the banking system of Ukraine demonstrated a high level of digital adaptation, as confirmed by data from the National Bank of Ukraine. This made it possible to ensure the continuity of financial operations and support economic activity [12].

A significant component of modern digital transformation is the development of military-tech and dual-use technologies, which combine military and civilian applications. Scientific studies note that these technologies not only increase the country's defense capability but also form new high-tech sectors of the economy that can become the foundation of its post-war development [15].

At the same time, the digitalization of the economy under wartime conditions is accompanied by the growth of cyber threats, which requires strengthening the cybersecurity system. The increase in the number of cyberattacks on state and financial institutions necessitates the formation of a comprehensive system for protecting digital infrastructure as an important element of economic security.

In the context of post-war recovery, digital transformation acquires strategic importance as the foundation for the formation of a new economic model. This means not only the reconstruction of destroyed infrastructure but also its modernization through the use of modern technological solutions.

Digital technologies play a key role in the restoration of critical infrastructure, the development of "smart" cities, and the digitalization of the energy and transport sectors. Their use makes it possible to increase the efficiency of resource management, ensure the transparency of economic processes, and create favorable conditions for attracting investments. In addition, digitalization contributes to Ukraine's integration into the European digital space, which opens new opportunities for the development of the innovative economy.

Under conditions of war and post-war recovery, digital transformation acts not only as a factor of innovative development but also as a key element in ensuring the resilience of the economic system. Its role lies in the formation of a new economic model based on innovations, digital technologies, and the principles of sustainable development.

3. Institutional mechanisms for ensuring the innovative development of the economy under conditions of war and post-war recovery

The formation of an innovative economy under modern conditions requires the presence of an effective institutional system that ensures the creation, dissemination, and commercialization of innovations. Institutional mechanisms play a decisive role in ensuring interaction between the main participants of the innovation process – the state, business, the scientific and educational environment, and civil society. In this context, the institutional environment acts as the foundation for the development of the innovative economy, determining the rules, norms, and conditions for the functioning of economic systems.

Institutional support for innovative development is considered a set of organizational, legal, and economic mechanisms aimed at stimulating innovation activity and creating a favorable investment climate. The development of the innovative economy in Ukraine largely depends on the effectiveness of state policy aimed at supporting scientific research, developing innovation infrastructure, and stimulating entrepreneurial activity.

A key element of institutional support is state innovation policy, which determines the strategic directions of economic development and forms mechanisms for supporting innovation activity. In Ukraine, the main guidelines of such policy are enshrined in strategic documents, particularly in the Innovation Development Strategy until 2030 approved by the Ministry of Economy of Ukraine. This document provides for the creation of conditions for the development of the innovation ecosystem, support for startups, the development of digital technologies, and the integration of Ukraine into the global innovation space.

An important component of the institutional environment is innovation infrastructure, which includes technology parks, business incubators, innovation clusters, and research centers. Their functioning contributes to the concentration of intellectual potential, the development of cooperation between science and business, and the acceleration of innovation commercialization processes. Under modern conditions, the development of innovation ecosystems that ensure the integration of various participants in the innovation process into a unified system acquires particular importance [1].

Alongside institutional mechanisms, economic instruments for stimulating innovation activity also play an important role, among which state financing of scientific research, tax incentives, grant programs, and venture investment should be highlighted. In Ukraine, the development of innovative entrepreneurship is supported, in particular, through the activities of the Ukrainian Startup Fund, which provides financing for innovative projects at the early stages of development.

In order to systematize the main institutional mechanisms and economic instruments, it is advisable to summarize their functional purpose in Table 2.

Table 2

Institutional mechanisms and economic instruments for ensuring the innovative economy

Mechanism	Essential characteristics	Role in the development of the innovative economy
State Innovation Policy	A set of development strategies and programs	Support for startups and commercialization of innovations
Innovation Infrastructure	Technology parks, incubators, clusters	Support for innovative enterprises
Venture Financing	Investment in innovative projects	Development of startups
Grant Programs	Financial support for innovations	Stimulation of research
Tax Incentives	Preferential taxation	Intensification of innovation activity

Source: compiled by the author based on [1]

As can be seen from the table 2 institutional mechanisms and economic instruments have a comprehensive character and ensure support for innovation activity at all stages of its development – from the generation of ideas to their commercialization. Their effective combination creates the preconditions for the formation of an innovative economy and increasing the competitiveness of the state.

At the same time, an important aspect is the relationship between the institutional environment and the digital transformation of the economy. Digitalization contributes to increasing the transparency of public administration, simplifying business procedures, and developing electronic services, which, in turn, positively affects the investment climate. Contemporary studies by the World Bank emphasize that digital institutions are an important factor of economic growth and innovative development.

In order to generalize the institutional mechanisms for ensuring the innovative economy, it is advisable to present a conceptual model of their interaction in Fig. 3.

As reflected in the figure, the key subjects of the institutional environment are the state, business, and the scientific and educational sphere, whose interaction is ensured through the system of regulatory and legal regulation, innovation infrastructure, and economic incentives. The synergy of these elements forms the foundation for the development of the innovative economy, contributing to increasing the efficiency of economic processes and ensuring sustainable development.

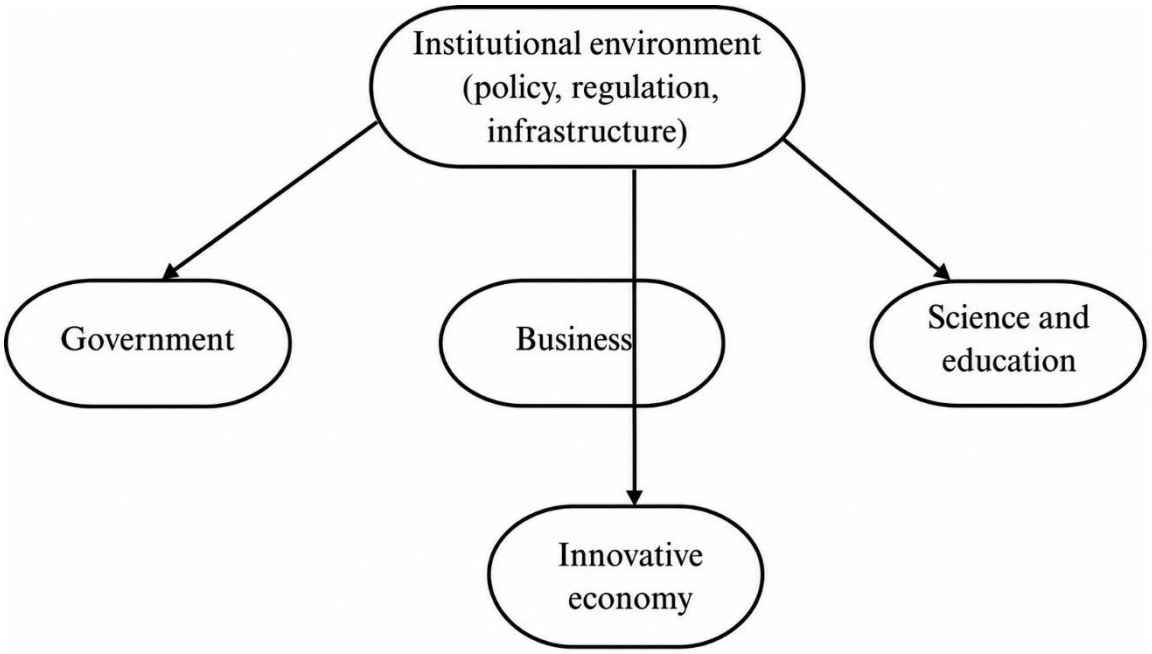

Figure 3. Conceptual model of institutional support for the innovative economy

Source: compiled by the author based on [1]

An important component of institutional support for the innovative economy is the development of the regulatory and legal environment, which determines the rules for the functioning of innovation activity and creates the preconditions for its intensification. In Ukraine, the legal regulation of innovation activity is based on a number of legislative acts, in particular the Law of Ukraine "On Innovation Activity", as well as strategic documents for economic development focused on digital transformation and integration into the global innovation space. At the same time, modern studies indicate the existence of certain institutional limitations related to insufficient consistency of regulatory and legal acts, a low level of coordination between state authorities, and limited financial resources for supporting innovations.

In this context, the formation of an effective system of public administration for innovative development acquires particular importance, involving the implementation of modern public administration instruments, digitalization of public services, and the development of e-governance. As noted in OECD reports, effective public administration is a key factor in ensuring innovative development, as it contributes to reducing administrative barriers, increasing transparency, and building trust between the state and business.

Alongside this, an important element of the institutional environment is the financial and economic mechanisms supporting innovation activity. Under modern conditions, the development of venture capital acquires particular importance, as it provides financing for innovative projects at the early stages

of development. In Ukraine, the venture investment market is gradually developing; however, its volumes remain limited compared to developed countries. According to analytical data from the Ukrainian Venture Capital and Private Equity Association, during 2021-2023 there has been growth in investments in technology startups, which indicates increasing investor interest in the innovative sector of the economy [18].

At the same time, grant programs implemented at both the national and international levels play a significant role in financing innovations. In particular, Ukrainian enterprises and scientific institutions actively attract funding within the framework of European Union programs such as Horizon Europe, which contributes to Ukraine's integration into the European research area. This not only makes it possible to obtain financial resources but also provides access to modern technologies and international partnerships.

The development of tax incentives as an instrument for supporting innovation activity is equally important. In global practice, mechanisms of tax benefits for enterprises engaged in innovation activity are widely used, particularly research and development (R&D) tax credits. In Ukraine, the implementation of such instruments is still at the development stage; however, their improvement can significantly influence the intensification of innovation activity.

Special attention should be paid to the development of innovation clusters as an effective form of organizing innovation activity. Clusters ensure the concentration of resources, the exchange of knowledge, and the development of cooperation between enterprises, scientific institutions, and government authorities. Under modern conditions, the cluster approach is considered one of the most effective mechanisms for increasing the competitiveness of the economy and stimulating innovative development.

An important aspect is also the relationship between the institutional environment and the processes of digital transformation. Digital technologies contribute to increasing the efficiency of institutional functioning, ensure the transparency of economic processes, and create new opportunities for the development of innovation activity. In particular, the implementation of electronic public service platforms, digital management tools, and open data contributes to the formation of a favorable environment for the development of business and innovation.

Under modern conditions of Ukraine's transformational economy, the adaptation of the institutional environment to new challenges, particularly those related to digitalization, globalization, and post-war economic recovery, acquires particular importance. This requires a comprehensive approach to reforming the institutional system, involving the improvement of the regulatory and legal framework, the development of innovation infrastructure, and the intensification of investment activity.

Under modern conditions of martial law, the institutional mechanisms for ensuring the innovative economy undergo significant transformation, which is caused by the necessity to adapt public administration, financial instruments, and innovation infrastructure to crisis conditions of functioning. War acts not only as a destructive factor but also as a catalyst for institutional changes aimed at increasing the flexibility, efficiency, and effectiveness of managerial decisions.

Under wartime conditions, the role of the state as a coordinator of innovative development is increasing, which is manifested in strengthening strategic planning, expanding business support programs, and intensifying international cooperation. In particular, there is a reorientation of state policy toward supporting critically important sectors of the economy, developing digital institutions, and stimulating technological innovations [6].

At the same time, the institutional environment adapts to new conditions through the simplification of regulatory procedures, digitalization of administrative services, and implementation of flexible mechanisms for supporting entrepreneurship. As evidenced by contemporary studies, digital instruments of public administration contribute to reducing administrative barriers and increasing the transparency of economic processes, which is especially important under conditions of wartime instability.

Particular importance is attached to the development of institutions supporting innovative entrepreneurship, particularly startup ecosystems, grant programs, and international funds. Under modern conditions, a significant part of financing for innovation activity is provided through international assistance, which contributes to Ukraine's integration into the global innovation space. This creates the preconditions for the formation of a new model of institutional support that combines national and international mechanisms for supporting innovations.

In the context of post-war recovery, institutional mechanisms acquire strategic importance, since they determine the effectiveness of implementing economic reconstruction programs. Contemporary scientific approaches emphasize the necessity of transitioning to a "smart recovery" model, which involves the integration of innovative technologies, digital solutions, and principles of sustainable development into reconstruction processes [15].

An important component of such a model is the development of the institutional capacity of the state, which includes improving the governance system, increasing the efficiency of resource utilization, and ensuring the transparency of financial flows. In this context, the digitalization of public administration acts as a key instrument for increasing the efficiency of the institutional system.

In addition, post-war recovery involves the intensification of investment activity, which requires the formation of a favorable institutional environment

for attracting domestic and foreign investments. As noted in contemporary studies, effective institutional mechanisms are a determining factor of investor confidence and ensure the stability of economic development [18].

Under conditions of war and post-war recovery, the institutional mechanisms for ensuring the innovative economy are being transformed toward increasing their adaptability, digitalization, and integration into the international economic space. This creates the preconditions for the formation of a new model of innovative development focused on resilience, efficiency, and long-term economic growth.

In the context of Ukraine's integration into the European economic space, it is advisable to conduct a comparative analysis of institutional mechanisms supporting innovation activity in Ukraine and the countries of the European Union in Table 3.

Table 3

Comparative characteristics of instruments supporting innovation activity in Ukraine and the EU (2021–2024)

Instrument	Ukraine	European Union
Grant Financing	Ukrainian organizations attract funding through international programs (particularly Horizon Europe)	Horizon Europe Programme (2021–2027)
State Support for Innovations	Innovation Development Strategy until 2030	Comprehensive EU innovation policy (European Innovation Area)
Venture Financing	The market is developing, while investment volumes remain limited.	Developed venture financing system (EIC, innovation funds)
Innovation Infrastructure	Technology parks, incubators, and clusters are being developed	Developed network of innovation ecosystems (EIT, KICs)
International Cooperation	Ukraine participates in EU programs under associated membership	High level of integration into global research networks

Source: compiled by the author based on [15; 18]

As evidenced by the presented data, the countries of the European Union have developed a more advanced system of institutional support for innovation activity, which includes significant volumes of financing, effective innovation infrastructure, and a high level of integration into global research networks.

In Ukraine, despite the existence of strategic documents and the gradual development of innovation infrastructure, the level of institutional support for the innovative economy remains lower, which is caused by limited financial

resources and insufficient integration into global innovation systems. At the same time, Ukraine's participation in international programs, particularly Horizon Europe, creates the preconditions for increasing the effectiveness of innovation activity and developing the national innovation ecosystem.

Institutional mechanisms and economic instruments for ensuring the innovative economy have a systemic character and encompass a wide range of interconnected elements. Their effective functioning is a necessary condition for the formation of a competitive economy capable of innovative development and ensuring sustainable growth.

4. Current state and strategic directions of the transformation of Ukraine's innovative economy

The current state of Ukraine's innovative economy is being formed under the influence of profound transformational processes caused both by global trends in digitalization and sustainable development and by internal challenges related to military actions. Under such conditions, innovative development acquires particular importance, as it acts as a key factor in ensuring the resilience of the economy, its adaptability, and its capacity for recovery. At the same time, the innovative economy is transforming into a multi-level system that combines technological, institutional, and socio-economic components, ensuring the formation of new sources of economic growth and increasing the competitiveness of the national economy.

In the pre-war period, the development of Ukraine's innovative economy was characterized by the gradual growth of the role of the IT sector, digital technologies, and research activity, which created the preconditions for integration into the global digital space. At the same time, existing structural problems, including the insufficient level of innovation financing, limited integration of science and business, the low level of commercialization of scientific research results, as well as the imperfection of the institutional environment, restrained the full realization of innovative potential. This necessitated the formation of an effective state policy in the field of supporting innovation activity and developing innovation infrastructure [13].

The full-scale war caused significant losses for the Ukrainian economy, including the destruction of critical infrastructure, reduction of production capacities, disruption of logistics chains, and decline in investment activity. At the same time, contemporary studies indicate that the war acts as a catalyst for structural changes, stimulating the development of high-tech sectors of the economy, particularly information technologies, digital services, and dual-use technologies [15]. Under such conditions, digital transformation becomes a determining factor in ensuring the continuity of economic processes, contributes to the development of remote forms of employment, and increases the integration of the Ukrainian economy into global markets.

Alongside this, there is a rethinking of the role of innovations in ensuring economic security and resilience, which is manifested in the growing importance of technological independence, the development of national innovation ecosystems, and the strengthening of interaction between the state, business, and the scientific and educational environment. The development of human capital, the improvement of digital competencies, and the formation of new employment models corresponding to the conditions of the digital economy acquire particular relevance.

The current state of Ukraine's innovative economy is characterized by a combination of crisis challenges and transformational opportunities, which creates the preconditions for the transition to a new development model focused on innovation, digitalization, technological modernization, and ensuring the long-term resilience of the economic system.

Under these conditions, the development of the IT sector acquires particular importance, as it demonstrates relative resilience and ensures the support of economic activity. This confirms the importance of the digital economy as one of the key factors of innovative development [13].

The analysis of the presented data indicates significant changes in the structure of Ukraine's innovative economy under conditions of martial law. In particular, there is a decline in the share of innovation-active enterprises and a reduction in financing for research and development activities, which is caused by a high level of economic uncertainty, limited financial resources, and increased risks of conducting economic activity. An additional restraining factor is the disruption of production and logistics chains and the reduction of investment activity, which negatively affects the development of the innovation sector. At the same time, certain sectors of the economy demonstrate relative resilience, particularly the IT industry, which continues to grow even during the period of martial law, ensuring stable foreign exchange revenues and supporting Ukraine's integration into the global digital space.

A significant factor in the transformation of the innovative economy is digitalization, which ensures the possibility of the functioning of the economy under conditions of limited access to physical infrastructure and contributes to increasing its adaptability to crisis challenges. The use of digital technologies makes it possible to optimize business processes, ensure the continuity of enterprise activities, develop remote forms of employment, and improve management efficiency. As noted in scientific studies, digital technologies contribute to supporting business processes, developing remote employment, and integrating Ukrainian business into global markets. In this context, digitalization acts not only as a factor of innovative development but also as an instrument for ensuring economic resilience [18].

Table 4

Key indicators of Ukraine's innovative development under wartime conditions

Indicator	Pre-war period (2019-2021)	Wartime period (2022-2024)	Trend
Share of Innovation-Active Enterprises	16-18%	10-12%	Decline
R&D Expenditures (% of GDP)	0,4%	0,3%	Decline
IT Exports	Stable growth	Growth	Resilience
Digitalization of Public Services	Medium level	High level	Growth
Investments in Innovations	Limited	Significantly reduced	Decline

Source: compiled by the author based on [13; 15; 18]

Alongside this, the issue of human capital development is becoming increasingly relevant, as it acts as a key resource of the innovative economy. The war has caused significant changes in the structure of the labor market, particularly migration processes, transformation of employment, and increased demand for digital competencies. This necessitates the modernization of the educational system, the development of lifelong learning, and the formation of new professional skills corresponding to the requirements of the digital economy. Particular importance is attached to the integration of education, science, and business as the foundation for the formation of an effective innovation ecosystem.

In the post-war period, innovative development is considered the foundation of economic recovery, which involves not only the technological modernization of production but also the formation of a new model of economic development focused on innovation, digitalization, and increasing the efficiency of resource utilization. Particular importance is attached to the development of innovation infrastructure, the attraction of investments, as well as the integration of modern management approaches into the processes of economic reconstruction. In this context, the implementation of innovative solutions is regarded as a key instrument for ensuring long-term economic growth and increasing the competitiveness of the national economy [6].

An important role is played by international support and Ukraine's integration into global innovation processes, which contributes to attracting investments and implementing advanced technologies. As noted in World Bank studies, effective institutional mechanisms are a key factor in ensuring economic growth and economic recovery [18].

The current state of Ukraine's innovative economy is characterized by a transition to a new development model formed under the influence of wartime challenges and post-war recovery processes. In this model, innovations act as a key factor in ensuring economic resilience, competitiveness, and long-term growth.

5. Integration model for the development of the innovative economy under conditions of digitalization, war, and post-war recovery

The current stage of the development of economic systems is characterized by profound transformational processes caused by digitalization, globalization, and the intensification of sustainable development challenges. Under these conditions, the innovative economy acts as a basic model for ensuring the effective functioning of national economies, the formation of competitive advantages, and the achievement of long-term economic growth. These processes acquire particular importance for Ukraine, whose economy operates under conditions of wartime challenges and requires the formation of a new development model focused on recovery, increasing resilience, and ensuring economic security [18].

In this context, the innovative economy is considered a complex multi-level system based on the use of knowledge, information, and technologies as key factors of production. Its development is closely connected with the concept of sustainable development, which involves achieving a balance between economic, social, and environmental goals. Such an approach necessitates the integration of innovative solutions into all spheres of economic activity, which contributes to increasing the efficiency of resource utilization, developing human capital, and minimizing negative environmental impact. At the same time, innovations act not only as an instrument of economic growth but also as a factor in increasing the adaptability of economic systems to external challenges [4].

A logical continuation of these transformations is digital transformation, which acts as a key factor of innovative development by ensuring the integration of technological, economic, and social processes. The use of modern technologies, particularly artificial intelligence, Big Data, the Internet of Things, and cloud solutions, contributes to increasing productivity, optimizing managerial processes, and forming new business models. Digitalization also ensures the transition to the data economy, in which information becomes a strategic resource for development. Scientific studies emphasize that digital transformation contributes to increasing the efficiency of business processes, developing remote employment, and integrating the national economy into global markets, which is especially relevant under conditions of martial law [6].

Under conditions of martial law, digital transformation acquires critically important significance, as it ensures the continuity of the functioning of the economy, public administration, and the financial system even under conditions of significant limitations of physical infrastructure. It contributes to the development of remote employment, business support, preservation of business activity, and integration of the economy into global markets. Studies indicate that digitalization has become one of the key factors in preserving Ukraine's economic activity during the war, ensuring the possibility of rapid adaptation of business entities to new conditions of functioning [11].

Table 5

The impact of digital technologies on the innovative economy and sustainable development

Digital technology	Impact on the economy	Impact on sustainable development
Artificial Intelligence	Automation	Optimization of resource utilization
Big Data	Analytics	Efficiency
Internet of Things	Monitoring	Energy efficiency
Cloud Technologies	Scaling	Cost reduction

Source: compiled by the author based on [6]

In this context, digital technologies act not only as an instrument for increasing efficiency but also as a mechanism for ensuring economic resilience.

Alongside this, digitalization creates the preconditions for the formation of a new economic model based on innovation, technological advancement, and a high level of adaptability to external challenges. A special role in this process is played by state digital services, which ensure the continuity of governance, access to administrative services, and increased transparency of interaction between the state, business, and citizens (Ministry of Digital Transformation of Ukraine). At the same time, the development of digital platforms contributes to reducing transaction costs, increasing the efficiency of managerial decisions, and creating conditions for the development of the digital economy as an integrated system.

A logical continuation of these processes is the transformation of the institutional environment, which plays a key role in ensuring innovative development. Institutional mechanisms create the conditions for realizing the innovative potential of the economy, determine the rules of interaction between economic entities, and influence the level of investment activity. Under wartime conditions, they are being adapted toward increasing flexibility, simplifying regulatory procedures, and developing digital public

administration. The role of the state as a coordinator of economic processes is increasing, ensuring business support, stimulation of innovation activity, and the formation of a favorable environment for post-war economic recovery.

The analysis of the current state of the innovative economy indicates a decline in overall innovation activity alongside the strengthening of the role of digital technologies as a factor of stabilization of the economic system. These trends are caused by the influence of wartime factors, particularly the limitation of financial resources, the decline in investment activity, and the increase in the level of economic uncertainty. At the same time, digital technologies ensure the possibility of adaptation of economic entities to new conditions of functioning, contribute to the preservation of business activity, and support key sectors of the economy. This confirms the necessity of transitioning to a new model of economic development that combines innovation, digitalization, and resilience as interconnected components of the modern economic system [3].

The development of these processes necessitates a reconsideration of the role of innovations in ensuring economic recovery. Innovative development is regarded as the foundation for forming an effective reconstruction model, which involves not only restoring lost economic potential but also its qualitative transformation. This includes the technological modernization of production, implementation of digital solutions, development of innovation infrastructure, and improvement of the efficiency of managerial processes. Contemporary studies emphasize that the innovative component is a key factor in effective economic recovery, as it ensures long-term competitiveness and resilience [6].

The generalization of theoretical approaches and the results of the analysis of the current state of the innovative economy makes it possible to proceed to the formation of an integration model for its development. Such a model reflects the interrelationship between technological, institutional, and socio-economic components of the economic system, ensuring their coordinated functioning. It creates the foundation for forming a comprehensive approach to the development of the innovative economy focused on increasing the efficiency of resource utilization, ensuring economic resilience, and achieving long-term economic growth under conditions of modern transformational challenges.

Table 6

Integration characteristics of the components of innovative economy development

Level	Elements	Result
Technological	AI, Big Data	Productivity
Institutional	Policy	Investments
Social	Education	Human Capital

Source: compiled by the author based on [3; 6]

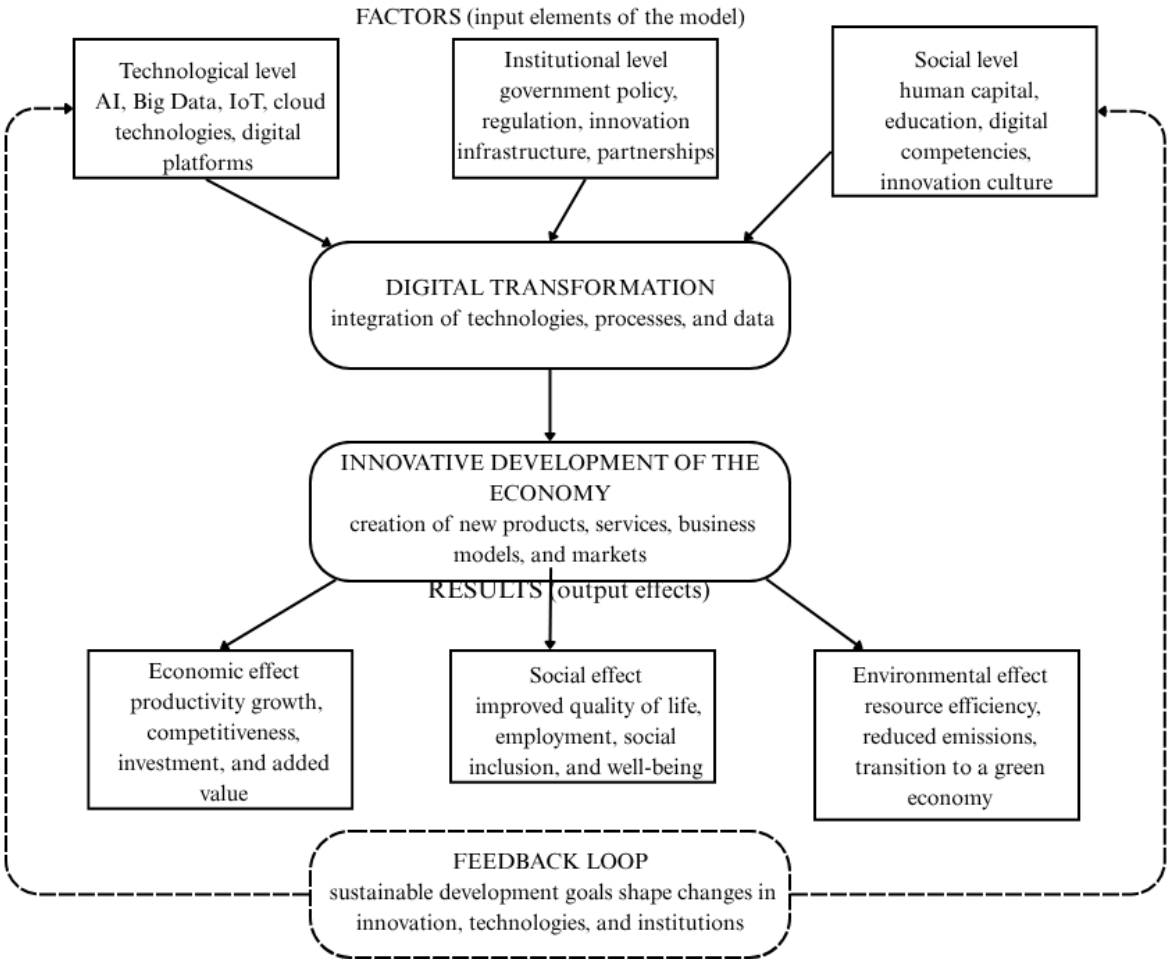

Figure 4. Integration model for the development of the innovative economy

Source: compiled by the author based on [3; 6; 12]

The integration model demonstrates that digital transformation acts as the foundation of innovative development, while the institutional environment ensures the conditions for the implementation of innovation activity and forms the necessary preconditions for effective interaction between economic entities. The interrelationship between technological, institutional, and socio-economic components within such a model ensures the integrity of the functioning of the innovative economy and contributes to increasing the efficiency of resource utilization. Under conditions of war and post-war recovery, the model acquires a dynamic character, which ensures the adaptation of the economy to changes in the external environment, increases its resilience to crisis phenomena, and enhances its capacity for rapid recovery [12].

Under such conditions, the innovative economy is transformed into a model focused on ensuring resilience, adaptability, and long-term development, which involves not only the restoration of economic potential but also its qualitative modernization. The implementation of this model requires a comprehensive

combination of digital technologies, institutional reforms, and the development of human capital as key factors of innovative growth. At the same time, strengthening interaction between the state, business, and the scientific and educational environment acquires particular importance, as it ensures the formation of an effective innovation ecosystem.

The integration model for the development of the innovative economy creates a conceptual foundation for the formation of a competitive economy of Ukraine capable of functioning effectively under conditions of modern transformational challenges, ensuring sustainable economic growth, and integrating into the global economic space.

Conclusions

The innovative economy under modern conditions emerges as a complex system that combines technological, institutional, and socio-economic components of development, ensuring the formation of new sources of economic growth and increasing competitiveness. Its formation is inseparably connected with the implementation of the principles of sustainable development, which involve achieving a balance between economic efficiency, social orientation, and environmental security.

A key factor in the transformation of the innovative economy is digital transformation, which ensures the integration of economic processes, the development of new business models, and the improvement of management efficiency. Under conditions of wartime challenges, digitalization acquires particular importance, as it contributes to preserving economic activity, ensures the continuity of the functioning of core systems, and increases the adaptability of the economy to changes in the external environment.

An important role in ensuring innovative development is played by the institutional environment, which determines the conditions for realizing innovative potential, contributes to the development of entrepreneurship, and facilitates the attraction of investments. Its transformation toward flexibility, digitalization, and openness creates the preconditions for the effective functioning of the economic system under conditions of uncertainty.

The current state of Ukraine’s innovative economy is characterized by the presence of structural changes caused by the influence of wartime factors, alongside the growing role of high-tech sectors that act as a driving force of economic resilience. This determines the necessity of transitioning to a development model focused on innovation, technological advancement, and the capacity for rapid adaptation.

The development of the innovative economy involves the formation of a comprehensive model that ensures the interaction of technological, institutional, and socio-economic elements aimed at increasing the efficiency of resource utilization, modernizing the economy, and ensuring its long-term

growth. Such a model creates the foundation for the formation of a resilient and competitive economic system capable of functioning effectively under conditions of modern global and national challenges.

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