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Sustainable Infrastructure Recovery and Local Economic Development in War-Affected Territories

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ABSTRACT:
The full-scale war in Ukraine has caused large-scale destruction of the infrastructure of territorial communities of Ukraine and significantly worsened the prerequisites for their local economic development. The processes of restoration of de-occupied and affected territories are especially difficult, where the physical reconstruction of infrastructure should be combined with the restoration of entrepreneurial activity, employment, human capital, financial capacity and spatial integrity of communities. The article is aimed at theoretical and methodological substantiation and empirical assessment of the relationship and coherence of infrastructure development and local economic development of the de-occupied and affected territories of Ukraine in the context of ensuring their sustainable development. A methodical approach to assessing the coherence of infrastructure recovery and local economic development based on integral indices of I_IR and I_LED and coefficient of coherence K_C is proposed. The author's 100-point matrix E–S–P–R–G is developed for prioritizing infrastructure projects by economic, social, spatial, security-sustainability and environmental effects. The possibility of integrating the proposed approach with the DREAM digital ecosystem is substantiated. The expediency of moving from an object-oriented model of reconstruction to a territorially oriented model of sustainable recovery, in which the priority of infrastructure projects is determined not only by the scale of physical destruction, but also by the potential for creating a comprehensive long-term effect for the territorial community, is proved.

Keywords: infrastructure, reconstruction, de-occupied territories, affected territories, local economic development, territorial community, coherence, sustainable development, resilience, DREAM, project prioritization.

1. Introduction

The full-scale armed aggression against Ukraine has caused large-scale destruction of residential, transport, energy, communal, medical, educational and industrial infrastructure, especially in the de-occupied and affected territories. Infrastructure losses are accompanied by a reduction in economic activity, the destruction of established economic ties, the displacement of the population and business entities, a decrease in employment, a deterioration in access to basic public services, and an increase in spatial

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and socio-economic disparities. Under such conditions, the restoration of infrastructure becomes important not only as a technical task for the reconstruction of destroyed facilities, but also as a systemic prerequisite for restoring the viability of territorial communities, revitalizing the local economy and ensuring sustainable development.

The study of the relationship between infrastructure development and local economic development of de-occupied and affected territories is of relevance. The restoration of transport links, energy supply, water supply and sewerage, housing, health care institutions, education and social infrastructure creates basic conditions for the return of the population, the restoration of entrepreneurial activity, the attraction of investments, the creation of jobs and the formation of new local value chains. At the same time, the economic revival of territories expands the financial base of local self-government and forms resources for further maintenance and modernization of the restored infrastructure. Thus, an interdependent cumulative effect arises between infrastructure restoration and local economic development, the study of which has an important theoretical and applied value.

In the context of sustainable development, it is fundamentally important to move from the model of simple reproduction of the pre-war state of territories to the model of "build back better". This approach assumes that reconstruction should simultaneously ensure economic efficiency, social inclusiveness, environmental safety, energy efficiency, spatial balance and resilience of infrastructure to future military, natural, man-made and socio-economic threats. Accordingly, it is advisable to assess the effectiveness of reconstruction not only by the number of restored facilities or the amount of attracted financial resources, but also by their impact on employment, entrepreneurial activity, investment attractiveness, availability of basic services, quality of life and the ability of territorial communities to long-term self-development.

This issue is of particular importance from the standpoint of public health. Damage to water supply and sewerage systems, medical, energy, transport, housing and communal infrastructure directly affects the living conditions of the population, the availability of medical care, sanitary and epidemiological safety and social well-being. Therefore, the infrastructural restoration of the de-occupied territories should be considered as one of the socio-economic determinants of public health. The restoration of economic activity, in turn, contributes to increasing employment and household incomes, reducing social vulnerability and building the financial capacity of communities to ensure the proper quality of public, social and medical services.

Mine and explosive contamination of territories add additional complexity to the recovery processes. Humanitarian demining is actually the initial condition for the safe return of the population, the restoration of agricultural production, the implementation of infrastructure and investment projects, the restoration of transport accessibility and the full use of land and other local resources. This necessitates the coordination of demining processes, infrastructure reconstruction and stimulation of local economic activity within a single system of territorial restoration. At the same time, the scientific and methodological problem of determining the extent to which the restoration of certain types of infrastructure is transformed into specific results of local economic and social development remains. The issues of assessing the consistency of the pace of infrastructure recovery and economic activation of territories, identifying infrastructure priorities with

the greatest multiplier effect, as well as the formation of a system of indicators that allows assessing not only the physical results of reconstruction, but also their contribution to the achievement of the Sustainable Development Goals remain insufficiently studied.

Thus, the scientific substantiation of the relationship between the development of the infrastructure of the de-occupied (affected) territories and local economic development is an urgent task of modern economic science and public administration practice. Its solution makes it possible to move from fragmentary restoration of individual objects to a comprehensive territorially oriented model of reconstruction, in which infrastructure acts as a driver of economic activation, improving the quality and safety of life of the population, strengthening the capacity of territorial communities and achieving long-term socio-economic and environmental sustainability.

2. Literature review

The issue of restoring the de-occupied and affected territories of Ukraine is becoming increasingly important in modern scientific discourse, covering the issues of infrastructure reconstruction, local economic development, spatial transformation, institutional capacity of territorial communities, resilience and ensuring sustainable development. The analysis of scientific publications indicates a gradual transition from understanding post-war reconstruction mainly as the physical restoration of destroyed objects to its interpretation as a comprehensive transformation of territories, which should simultaneously provide economic, social, spatial, security and environmental results.

A significant contribution to the formation of the conceptual foundations of Ukraine's sustainable recovery was made by Cifuentes-Faura (2023), which considers post-war reconstruction through a combination of the principles of sustainable development, digitalization, energy efficiency, and the formation of "smart" cities and management systems. This approach fundamentally expands the traditional interpretation of reconstruction, since restoration should be aimed not at the mechanical reproduction of the pre-war state, but at the structural modernization of territories. The position of Unver et al. (2025) is close, which, exploring the prospects for the sustainable recovery of Ukraine's construction stock, substantiates the need for a strategic combination of reconstruction with energy efficiency, environmental friendliness, and long-term sustainability.

The connection between recovery processes and the achievement of the Sustainable Development Goals is revealed by Stavytskyy and Kharlamova (2025). Scientists emphasize the need to integrate the tasks of reconstruction of Ukraine with long-term sustainable development guidelines. This is especially important for territorial communities, since the effectiveness of recovery should be determined not only by the number of reconstructed facilities, but also by changes in the availability of services, economic activity, quality of life, environmental characteristics and sustainability of the territory.

An essential area of modern research is to determine the role of **resilience** in the restoration of territories and infrastructure. Birkmann et al. (2023), studying reconstruction after large-scale emergency events, prove the need to use the reconstruction process to increase the ability of territorial systems to withstand future shocks. Recovery in this

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context should not reproduce previous vulnerabilities but create more resilient infrastructure and management systems. A similar logic is developed by Chester et al. (2021), who link post-crisis infrastructure recovery with the formation of resilience and the implementation of the *Build Back Better principle*. Accordingly, the criterion of resilience should be laid down already at the stage of selection, design, and implementation of infrastructure projects.

The results of Kopiika et al. (2025) are especially important for the development of the methodology for prioritizing infrastructure projects. The authors proposed an approach to prioritizing the restoration of critical infrastructure after large-scale disasters and conflicts, which is based on the simultaneous consideration of the criteria of sustainability and resilience. The practical orientation of this approach confirms the need to move from determining the sequence of reconstruction solely by the scale of physical damage to a multi-criteria assessment of the social impact of infrastructure projects. At the same time, it is advisable for the level of territorial communities to expand the range of criteria by simultaneously taking into account the economic, social, spatial, security-sustainability, and environmental consequences of recovery.

The spatial dimension of Ukraine's post-war reconstruction is presented in the studies of Danylyshyn (2024) and Lysyak and Karyy (2025). Danylyshyn (2024) emphasizes the need for strategic management of the spatial restoration of communities and regions of Ukraine and its alignment with European principles of regional development. At the same time, Lysyak and Karyy (2025), studying transformation processes in the de-occupied territories, focus on the need for an integrated spatial approach, in which infrastructural restoration should be associated with changes in the functional structure of the territory, the settlement system and the prospects for its further development. This formulation of the question is especially important given the fact that the mechanical reproduction of the pre-war spatial structure does not always correspond to the current demographic, economic and security situation.

Infrastructure restoration is closely related to local economic development. Protsak et al. (2025) substantiate the need for an integrated approach to the post-war reconstruction of territorial communities, which involves combining infrastructure restoration with the development of human capital, entrepreneurship, and strategic management. Fedorenko (2026) considers the strategization of local economic development in the context of security challenges and post-war recovery, which actualizes the need to include economic results in the system for assessing the effectiveness of reconstruction. The restoration of roads, energy systems, communal and digital infrastructure should create conditions for the restoration of enterprises, the emergence of new business entities, the creation of jobs, the attraction of private investment and the expansion of the revenue base of local budgets.

The financial mechanisms of Ukraine's infrastructural development in the context of post-war economic transformation are studied by Hrynchyshyn and Rusin (2026). In this context, the problem of limited financial resources is of particular importance, which necessitates an economically justified determination of the order of recovery. In the presence of a significant number of damaged facilities and limited capabilities of the state and local budgets, the principle of "restoring everything at once" is almost impossible. Therefore, priority should be given to projects capable of forming the largest cumulative

territorial and multiplicative effect and creating preconditions for further self-sustaining development of the local economy.

The inclusive dimension is important for understanding the economic recovery of communities. Kraievska (2026) links the post-war reconstruction of the local economy with the need to ensure inclusiveness of recovery processes. This involves taking into account the needs of different categories of the population, creating opportunities for economic participation, employment and access to public services. Therefore, the social effect of infrastructure investments should be assessed along with their immediate economic outcome.

The institutional dimension of recovery is presented in studies by Rabinovych et al. (2024), Dyakonenko and Nechytailo (2024) and Czech (2026). Rabinovych et al. (2024) demonstrate the importance of local governance and the results of decentralization in ensuring Ukraine's resilience in times of war. This allows us to consider the institutional capacity of territorial communities as one of the key prerequisites for effective recovery management. Dyakonenko and Nechytailo (2024) draw attention to the potential of civil society organizations in the reconstruction of territorial communities, emphasizing the role of social capital, partnerships, and civic participation. Czech (2026) expands the discussion on recovery beyond physical infrastructure, emphasizing the role of institutions and political-economic mechanisms of reconstruction. Therefore, even significant amounts of capital investment alone do not guarantee a sustainable territorial effect without proper quality of local governance, coordination and institutional capacity.

The problem of coherence between infrastructure recovery and local economic development is considered by Zablodska et al. (2024), where the need to assess the coherence of sustainable construction and local economic development of de-occupied and affected territories is substantiated. Such a statement of the problem is fundamentally important, since a significant pace of physical reconstruction is not necessarily accompanied by a proportional recovery of entrepreneurial activity, employment, investments, and budget revenues. Accordingly, assessing the effectiveness of reconstruction requires a transition from the analysis of individual infrastructure indicators to determining the degree of coherence of infrastructure and economic processes.

The analysis of the scientific literature allows us to identify several interrelated conceptual areas of post-war recovery research: sustainable development and the principle of Build Back Better; infrastructure resilience; spatial transformation of de-occupied territories; local economic development; institutional capacity and inclusiveness; multi-criteria prioritization of infrastructure projects. Together, they form the theoretical basis for considering infrastructure reconstruction as a comprehensive tool for territorial development.

At the same time, the review showed the existence of a scientific and methodological gap. Firstly, infrastructural recovery and local economic development are mostly assessed separately, while the methodological toolkit for determining the degree of their coherence remains underdeveloped. Secondly, existing approaches to prioritizing infrastructure projects mostly focus on individual characteristics — the scale of damage, criticality, cost, sustainability, or resilience — while the complex combination of economic, social, spatial, security-sustainability, and environmental effects at the level of the territorial community requires further methodological development. Thirdly, the combination of ex

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ante prioritization of projects with ex post assessment of how actual infrastructural recovery is transformed into the results of local economic development remains insufficiently studied.

The identified scientific gap determined the logic of this study and the need to develop an integrated approach that combines the assessment of the level of infrastructure recovery (I_IR), local economic development (I_LED) and their coherence (K_C) with a multi-criteria assessment of the priority of infrastructure projects by economic (E), social (S), spatial (P), security-resilient (R) and environmental (G) blocks. This combination creates a methodological basis for the transition from object-oriented reconstruction to territorially oriented sustainable recovery, in which infrastructure investments are evaluated from the standpoint of their ability to generate a long-term comprehensive effect for the territorial community.

The proposed integrated approach complements existing approaches to post-war recovery by linking them to the assessment of the actual coherence between infrastructure recovery and local economic development. In particular, it strengthens the resilience, spatial transformation, institutional capacity, inclusiveness, and sustainable development dimensions by considering the extent to which infrastructure investments contribute to corresponding economic outcomes and generate a comprehensive territorial effect. This provides a more holistic view of recovery, in which infrastructure, economic, social, spatial, security, and environmental aspects are considered in an interconnected manner.

3. Aim of the research

The article is aimed at theoretical and methodological substantiation and empirical assessment of the relationship and coherence of infrastructure development (restoration) and local economic development of de-occupied and affected territories of Ukraine in the context of ensuring their sustainable development, as well as determining priority areas for strengthening the economic, social and spatial effects of infrastructural restoration of territorial communities.

4. Methodology

The methodological basis of the study is systematic, comprehensive, territorial and sustainable approaches to the study of the processes of infrastructural restoration and local economic development of the de-occupied and affected territories of Ukraine. The systematic approach is used to consider infrastructure, local economy, social sphere, spatial organization and security as interrelated components of the functioning of the territorial community. The integrated approach ensured the simultaneous consideration of the economic, social, spatial, security and environmental consequences of infrastructural restoration. The territorial approach was used to consider the specifics of the de-occupied and affected communities, the scale of destruction, the spatial location of facilities, the availability of services, the localization of economic activity and the peculiarities of the restoration of individual settlements.

The study uses methods of theoretical generalization and systematization to determine the essence and features of infrastructural restoration of territorial communities,

establishing its place in ensuring local economic and sustainable development. The method of analysis and synthesis is used to identify the main components of infrastructure restoration and the mechanisms of their impact on entrepreneurial activity, employment, investments, local budget revenues, quality of life of the population and spatial integration of the territory.

To study modern scientific approaches to the restoration of de-occupied and affected territories, the method of critical analysis of scientific literature was used. The comparative method was used to compare theoretical provisions, existing approaches to sustainable recovery and actual trends in the development of territorial communities.

A special place in the methodology is occupied by the coherent approach, which is used to determine the degree of coherence of the processes of infrastructure recovery and local economic development. Its application allows assessing reconstruction not only by the physical results of reconstruction, but also by the position of correspondence of the intensity of infrastructure recovery to changes in the economic activity of the territory.

For empirical assessment, the index method is used, which provides a generalization of a set of heterogeneous indicators of infrastructure and economic development. The normalization method is used to bring the indicators presented in different units of measurement to a comparable form. On this basis, the formation of integral characteristics of the level of infrastructure recovery and local economic development is provided.

The methods of dynamic and comparative analysis are used to determine changes in indicators over time, establish directions and rates of recovery, and identify disproportions between the physical reconstruction of infrastructure and economic activation of the territory. If there are enough statistical observations, correlation analysis can be used as an additional tool to determine the strength and direction of the statistical relationship between infrastructure and economic indicators.

To substantiate the sequence of project implementation, the method of multi-criteria evaluation was used. It was implemented through the author's matrix of prioritization of infrastructure projects, which considers five groups of effects: economic (E), social (S), spatial (P), security and sustainable (R), environmental (G). The level of project impact according to the respective criteria and the overall project score were determined using a point-based scale followed by weighting with the assigned coefficients. For this purpose, an adaptation of Ken Brown's (1993) 10-Point Test of Financial Condition was applied, which involves ranking indicator values, dividing them into quartiles, and assigning corresponding scores (Kaziuk and Ventsel , 2024).

The case study method is used for an in-depth study of the processes of infrastructural restoration on the example of the Ivankiv settlement territorial community as a territory that has been subjected to occupation, military destruction and subsequent restoration. This approach allows us to test the proposed theoretical and methodological provisions on the actual data of a particular territorial community.

The information basis of the empirical study was the official data of state authorities and local self-government, materials of the Ivankiv village council, strategic and program documents of the territorial community, as well as information from the digital ecosystem of recovery management DREAM. The use of DREAM data provides an

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opportunity to study the parameters of infrastructure projects, their status and funding and creates an information basis for evaluating and prioritizing recovery projects.

The cumulative application of these methods and approaches provides a combination of theoretical, empirical and applied levels of research and allows us to consider infrastructural restoration as a tool for intensifying local economic development and forming prerequisites for long-term sustainable development of de-occupied and affected territorial communities.

5. Results

5.1. Theoretical and methodological substantiation of the relationship between infrastructure development and local economic development of de-occupied and affected territories

The restoration of the de-occupied and affected territories of Ukraine is a complex multidimensional process, within which the reconstruction of infrastructure should be considered not as an independent direction of reconstruction, but as one of the basic factors for the restoration of economic activity, social stability, spatial integrity and long-term sustainability of territorial communities. This approach corresponds to the modern paradigm of sustainable development, according to which the economic, social, environmental and institutional components of territorial development are interconnected.

Cifuentes-Faura (2023) substantiates the need to move from the mechanical reproduction of the pre-war state of Ukrainian territories to a reconstruction model focused on sustainability, energy efficiency, digitalization, technological modernization, and smart development principles. Accordingly, infrastructural reconstruction should create not only restored physical assets, but also new prerequisites for economic activity and improving the quality of life of the population. A similar logic can be traced in the study by Unver et al. (2025), which emphasizes the need for territorial differentiation of reconstruction depending on the scale of destruction, the type of territory, local needs, and resource capabilities.

In this context, the development of the infrastructure of the de-occupied and affected territories is proposed to be interpreted as a systemic process of restoration, modernization and structural transformation of a set of industrial, transport, energy, housing and communal, social and digital facilities and networks, aimed at restoring the basic functions of the territory, intensifying local economic activity and forming the prerequisites for its long-term sustainable development.

5.1.1. The theoretical relationship between infrastructure and local economic development should be considered through several complementary mechanisms.

The first is the resource and restoration mechanism. The restoration of electricity, gas and water supply, transport accessibility, digital communications and production infrastructure creates the minimum necessary conditions for the resumption of economic activity. Without basic infrastructure, the territory actually loses its ability to perform economic functions regardless of the availability of other development resources.

The second is the investment mechanism. The quality and accessibility of infrastructure determine a significant part of territorial transaction costs, and therefore directly affect the investment attractiveness of the community. The restoration of roads, energy systems, logistics networks, and digital infrastructure reduces the risks of doing business and creates prerequisites for the return of relocated enterprises and the attraction of new investments.

The third is the multiplier mechanism. Investments in reconstruction create the primary demand for building materials, transport, engineering, design, and other services. This contributes to the creation of jobs, the formation of incomes of the population and enterprises, an increase in consumer demand, and, subject to the localization of relevant economic effects, the growth of local budget revenues. It is the possibility of forming such a relationship between sustainable construction and the local economic development of the de-occupied and affected territories that Zablodska et al. (2024) draw attention to.

The fourth mechanism can be defined as socially reproductive. The restoration of housing, health care institutions, education, social protection and other social infrastructure facilities is a prerequisite for the return of the population and stabilization of the human capital of the territories. Economic recovery without the restoration of the social environment has limited sustainability due to the shortage of labor resources and the decrease in the attractiveness of the territory for permanent residence.

The fifth, the fiscal and institutional mechanism, is implemented through the relationship between economic activity and the financial capacity of local self-government. The restoration of entrepreneurship and employment expands the tax base of the community, which creates additional opportunities for maintenance, modernization, and further development of infrastructure. At the same time, Rabinovych et al. (2024) show the importance of local management capacity and the results of decentralization for the resilience of Ukrainian communities during the war.

Therefore, the causal relationship is not linear, but cyclical-cumulative in nature: infrastructural restoration → improving the accessibility and functionality of the territory → restoring entrepreneurship and investment → employment and incomes → increasing the local tax base → increasing the financial capacity of the community → further investment in infrastructure → increasing territorial resilience.

At the same time, for the de-occupied territories, it is necessary to include another fundamental prerequisite for this chain — security and humanitarian demining, without which the use of restored infrastructure, land, production assets, and transport networks may remain limited.

5.1.2. Coherence of infrastructural and local economic development

The existence of a theoretical relationship between infrastructure investments and economic development does not automatically mean the emergence of a positive territorial effect. Significant amounts of funding can ensure the rapid physical recovery of facilities but not be accompanied by a proportional recovery of entrepreneurship, employment, investments, or the budgetary capacity of the community.

That is why it is methodologically important to apply the category of coherence. Within the framework of this study, the coherence of infrastructure development and local economic development is proposed to understand the degree of consistency of the

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direction, pace and results of infrastructure recovery with the dynamics of key parameters of local economic development, in which infrastructure restoration creates measurable economic, social and spatial effects and contributes to increasing the long-term sustainability of the territory.

Accordingly, it is necessary to distinguish at least three states of interaction. Positive coherence is observed when an improvement in infrastructure recovery indicators is accompanied by positive dynamics of the local economy. Weak or asymmetric coherence occurs when significant physical recovery of infrastructure is accompanied by minor changes in economic indicators or economic recovery occurs faster than infrastructure recovery. Negative coherence is characterized by multidirectional dynamics, when, for example, an increase in infrastructure recovery is combined with a reduction in entrepreneurial activity, employment or local incomes. The proposed approach is consistent with the conclusions of Lysyak and Karyy (2025) on the need for comprehensive spatial restoration of the de-occupied territories and allows to move from assessing individual reconstruction results to determining their compliance with the socio-economic dynamics of the territory.

5.1.3. Methodical approach to empirical assessment

For an empirical assessment of the relationship, it is advisable to form two groups of indicators: infrastructure recovery (I) and local economic development (E). The first group may include: the share of restored housing stock; the share of restored roads; the level of restoration of electricity, heat and water supply; the share of restored educational institutions; the share of restored health care institutions; the level of restoration of digital infrastructure; the share of restored or modernized production infrastructure facilities; the volume of capital investments in restoration per inhabitant. The second block should be formed from the following indicators: the number of operating business entities; the number of newly created enterprises; the level of employment; the number of jobs; local budget revenues; tax revenues from economic activity; capital investments; the volume of products sold; average wages; the number of the population that returned to the community.

To ensure comparability of different-sized indicators, it is advisable to normalize them. For stimulant indicators, the following ratio can be used:

$$xi^n = xi / xi(max),$$

where:

xi^n is the normalized value of the i-th indicator;

xi is the actual value; $xi(max)$ is the maximum value of the corresponding indicator in the studied population or time series.

After normalization, two integral indices are formed:

$$I_IR = \Sigma w_i x_i^n,$$

where:

I_IR is the integral index of infrastructure recovery;

wi is the weight coefficient of the corresponding infrastructure indicator.

Similarly:

$$I_LED = \Sigma v_j y_j^n,$$

where:
I_LED is the integral index of local economic development;
vj is the weight coefficient of the economic indicator;
yj" is its normalized value.

For a direct assessment of coherence, it is proposed to use the coefficient:

$$K_C = 1 - |I_IR - I_LED|,$$

where:
K_C is the coefficient of coherence of infrastructure recovery and local economic development.

Provided that both integral indices are normalized in the range [0; 1], the *coefficient K_C* also acquires values from 0 to 1. Approaching its value to 1 indicates a high degree of correspondence between the levels of infrastructure and economic recovery, while approaching 0 indicates a significant asymmetry between them. To interpret the results, a scale, table 1, is proposed.

Table 1. Scale of interpretation of assessment results

K_C Value	Coherence Level	Interpretation
0.80–1.00	High	Infrastructure and economic recovery are largely coherent
0.60–0.79	Sufficient	Coherent dynamics prevail, although some disparities remain
0.40–0.59	Moderate	Significant structural or temporal gaps are present
0.20–0.39	Low	Infrastructure recovery is weakly translated into economic outcomes
0.00–0.19	Critically low	Significant asymmetry between recovery processes is observed

Source: Developed by the authors

At the same time, a high *K_C* does not necessarily mean a positive result, since two low integral indices can be close. Therefore, the coefficient of coherence must be interpreted in combination with the absolute values of I_IR and I_LED. For example, *I_IR = 0.25* and *I_LED = 0.27* will characterize high formal consistency, but a low overall recovery rate. Instead, *the combination of I_IR = 0.82 and I_LED = 0.79* will indicate both a high level of development and its high coherence. Therefore, for analytical interpretation, it is proposed to use the matrix "infrastructural recovery – local economic development", which forms four basic types of territories, table 2.

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Table 2. Basic types of territories in relation to local economic development

	High I_LED	Low I_LED
High I_IR	Sustainable coherent recovery	Infrastructure-led recovery
Low I_IR	Economically advanced recovery	Stagnating recovery

Source: Developed by the authors

The proposed threshold values of the coherence coefficient and the territorial typology are, in essence, methodological tools for structured analytical interpretation of the results. However, their empirical validity requires further verification across a broader set of territorial communities that differ in their initial level of development, recovery conditions, and recovery trajectories. Nevertheless, the most desirable scenario remains the transition of a territory to the "sustainable coherent recovery" quadrant, in which a high level of infrastructure recovery is accompanied by a corresponding level of local economic activity.

5.1.4. Coherence and sustainable development of the territory

Methodologically, it is important to include the third dimension — sustainable development — in the model. Infrastructure reconstruction and economic growth cannot be considered sufficiently effective if they are accompanied by a deterioration of the environmental situation, social inequality, low availability of basic services or insufficient resilience of infrastructure to future risks.

Stavytskyy and Kharlamova (2025) emphasize the need to integrate the Sustainable Development Goals into the recovery process of Ukraine. Accordingly, it is advisable to correlate the proposed methodological approach primarily with SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 16 (Peace, Justice and Strong Institutions) and SDG 17 (Partnerships for the Goals).

The generalized theoretical and methodological construction of the study takes the following form: security and demining → restoration and modernization of infrastructure → restoration of accessibility and functionality of the territory → intensification of entrepreneurship and investment → employment and incomes → financial capacity of the community → reinvestment in territorial development → social and economic sustainability → sustainable development. At the same time, there are feedback loops between individual elements. In particular, the growth of economic activity increases the budgetary capacity of the community, which, in turn, creates opportunities for further modernization of infrastructure. Thus, a positive cumulative recovery cycle is formed.

The theoretical and methodological generalization allows us to assert that it is advisable to assess the infrastructural restoration of de-occupied and affected territories not only by physical indicators of reconstruction. Its effectiveness is determined by the ability of the restored infrastructure to generate economic, social and spatial effects. That is why the coherence of infrastructure restoration and local economic development can be considered as one of the characteristics of the effectiveness of reconstruction and a prerequisite for the transition from simple restoration of damaged objects to a model of sustainable territorial development.

5.2. Identification of priority areas for strengthening the economic, social and spatial effects of infrastructural restoration of territorial communities

Infrastructural restoration of de-occupied and affected territorial communities should be focused not only on the physical reproduction of destroyed or damaged objects, but also on the formation of long-term economic, social and spatial effects. This approach corresponds to the modern understanding of sustainable recovery and involves a transition from the logic of "reconstruction of objects" to the logic of "restoration of the functionality of the territory". The results of the theoretical generalization indicate that the volume of investments in infrastructure restoration alone cannot be a sufficient criterion for its effectiveness. More important is the extent to which the created or restored infrastructure assets contribute to the return of the population, the activation of entrepreneurship, the creation of jobs, the increase in local budget revenues, the increase in the availability of basic services, the restoration of economic ties and the reduction of spatial disparities. Accordingly, it is advisable to determine the priority of infrastructure projects by their ability to create a multiplicative territorial effect.

Taking into account the provisions of Cifuentes-Faura (2023), Danylyshyn (2024), Zablodska et al. (2024), Rabinovych et al. (2024), Lysyak and Karyy (2025), Protsak et al. (2025), Stavytskyy and Kharlamova (2025) it is proposed to systematize the priority areas for strengthening the effectiveness of infrastructure recovery into three interrelated blocks: economic, social and spatial.

5.2.1. Identification of priority areas of infrastructural restoration of territorial communities

The priority should be to ensure the maximum integration of infrastructure projects with the tasks of local economic development. The restoration of transport, energy, utilities and digital infrastructure should be directly related to the needs of existing and potential business entities. Of particular importance is the restoration of infrastructure that provides access to energy resources, transport corridors, logistics centers, digital networks, land and production resources. In this case, the infrastructure is transformed from an object of budget financing into an economic asset of a territorial community capable of generating long-term economic effects.

The second direction is to strengthen the localization of the economic effect of reconstruction. A significant part of the financial resources directed to reconstruction can leave the territory in the form of payments to external contractors, suppliers of materials and services. Under such conditions, the community receives the restored object, but the economic multiplier from the relevant investments is localized outside its borders. Therefore, it is expedient to involve local enterprises, labor resources, manufacturers of building materials and service providers in the implementation of restoration projects as much as possible, within the framework of legislation and competitive procedures. This will transform reconstruction costs into local business and population incomes, employment and tax revenues.

The third direction is the use of infrastructure reconstruction as a tool for attracting private investment. The restoration of basic networks should be synchronized with the creation of industrial and logistics sites, production zones, business incubators and other entrepreneurship infrastructure. Thus, a sequence is formed: infrastructure

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investments → reducing territorial costs and risks → improving business conditions → private investment → creating jobs → expanding the tax base → increasing the financial capacity of the community.

The social effect of infrastructural restoration consists in the restoration of housing, educational and health care institutions, social services, water supply and sewerage systems should be evaluated from the standpoint of a real improvement in the living conditions of the population. The key criterion of social effectiveness is not the number of reconstructed facilities, but the restoration of the availability of basic services. For example, the reconstruction of a health care institution should be evaluated not only by the fact of completion of construction work, but by changes in the number of people who have gained access to medical services, the time of transport accessibility to the institution, the range of services and the actual load on the relevant infrastructure. A similar approach should be applied to education, social protection, culture and other public services. A separate aspect is the creation of infrastructural conditions for the return of the population. For areas that have experienced a significant outflow of residents, physical infrastructure restoration without synchronous job creation and affordable housing may not provide demographic recovery.

Therefore, it is necessary to form an integrated model: housing + jobs + transport + education + health care + security = prerequisites for the return and consolidation of the population. In this context, the barrier-free nature of the new and reconstructed infrastructure is of particular importance, as the war increases the number of people with disabilities and other mobility restrictions. Universal design and physical accessibility should not be considered as additional characteristics of the facility, but as basic criteria for sustainable recovery, which are appropriate to use in the DREAM system.

The spatial effect of infrastructural restoration involves the mechanical reproduction of the pre-war territorial structure, if it does not correspond to the new demographic, economic, or security situation. Lysyak and Karyy (2025) emphasize the need to take into account the transformation of the spatial structure of the de-occupied territories. The war changes the resettlement of the population, the localization of enterprises, traffic flows, the structure of land use, and the functional connections between settlements. This implies the concentration of resources primarily on those objects and territories that are able to provide the maximum inter-settlement and inter-sectoral effect. For example, the restoration of a road, which simultaneously provides access to the population of several settlements to the administrative center, hospital, educational institution, and main places of employment, has a higher spatial effect than the reconstruction of an object with a limited area of influence. That is, the formation of a core infrastructure network of the community. It is advisable to include facilities that are critically necessary for the functioning of the entire territorial system: main transport links, energy hubs, water supply systems, health care and education institutions, administrative and logistics centers, digital infrastructure. The restoration of such a network should precede the reconstruction of facilities of local or secondary importance.

The specifics of the de-occupied and affected territories require the allocation of security as a cross-cutting condition for the economic, social and spatial effectiveness of recovery. First, we are talking about humanitarian demining and clearance of territories from explosive ordinance. Infrastructure investments cannot fully generate economic and

social effects if access to adjacent lands, production facilities, transport routes or natural resources remains limited. Therefore, a sequence is appropriate: assessment of security risks → demining → restoration of critical infrastructure → restoration of social infrastructure → intensification of economic activity → private investment → sustainable development of the territory. At the same time, such a sequence does not have to be purely linear: individual processes can and should be implemented in parallel depending on the security situation and the functional significance of the territory. Generalization of the analysis allows you to systematize the directions of managerial influence, Table 3.

Table 3. Priority areas for enhancing recovery effects

Component	Priority Area	Implementation Instruments	Expected Effect
Economic	Restoration of infrastructure supporting economic activity	Roads, energy networks, logistics, digital infrastructure	Recovery and development of entrepreneurship
Economic	Localization of reconstruction effects	Involvement of local labour resources and businesses	Employment, income, tax revenues
Economic	Attraction of private capital	Investment sites, public-private partnerships (PPPs), industrial parks	Private investment
Economic	SME development	Business infrastructure, grant and credit mechanisms	Diversification of the local economy
Social	Restoration of housing infrastructure	Reconstruction and new construction	Population return
Social	Accessibility of basic services	Education, healthcare, social protection	Improved quality of life
Social	Accessibility and barrier-free environment	Universal design	Social inclusion
Social	Human capital recovery	Vocational training and retraining	Alignment of workforce skills with recovery needs
Spatial	Development of a core infrastructure network	Identification of functionally significant facilities	Optimization of infrastructure location
Spatial	Inter-settlement accessibility	Roads and public transport	Reduction of spatial isolation
Spatial	Functional integration	Spatial and strategic planning	Balanced community development
Spatial	Inter-municipal cooperation	Joint infrastructure projects	Economies of scale
Security	Demining of territories	Humanitarian demining	Safe use of territories

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Security	Resilience of critical infrastructure	Decentralized systems and backup capacities	Community resilience
Environmental	Green recovery	Energy efficiency, renewable energy sources, circular technologies	Reduced resource intensity and environmental impact

Source: Developed by the authors

5.2.2. Methodical approach to prioritizing infrastructure projects

Considering the above, it is proposed to select infrastructure projects not only according to the level of physical damage, but on the basis of their cumulative territorial effect, unfortunately, DREAM does not use systems.

To do this, it is advisable to evaluate each project according to five blocks of criteria: E (economic effect), S (social effect), P (spatial effect), R (security effect), G (environmental effect). The integral priority of the project can be represented as:

$$Pi = w_1Ei + w_2Si + w_3Pi + w_4Ri + w_5Gi,$$

where:
Pi is the integral priority level of the i-th infrastructure project;
Ei, Si, Pi, Ri, Gi normalized estimates of the corresponding effects;
$w_1 ... w_5$ is the weighting coefficients, the sum of which is equal to 1.

For the de-occupied territories, it is advisable to set the scales taking into account the security situation and the stage of recovery. At the initial stage, security and social criteria may have greater weight, while at the stage of transition from reconstruction to long-term development, economic, spatial and environmental criteria may have more weight. This allows you to move from the principle of "restoring the most damaged" to the principle of "restoring first what provides the greatest cumulative effect for the functioning and sustainable development of the territory".

6. Discussion

To increase the validity of management decisions regarding the sequence of implementation of infrastructure projects in the de-occupied and affected territories, the author's multi-criteria prioritization matrix is proposed, which is based on the assessment of five groups of effects: economic (E), social (S), spatial (P), security (R) and environmental (G). The methodological approach is based on the principle that an infrastructure project should be evaluated not only by the scale of physical destruction of the object or its cost, but by its potential contribution to the restoration of the functionality of the territory, activation of the local economy, improving the quality of life of the population, spatial integration, security and environmental sustainability. The integral indicator of project priority is proposed to be calculated according to the formula:

$$IPi = Ei + Si + Pi + Ri + Gi,$$

where:
IPi is an integral indicator of the priority of the i-th infrastructure project, points;
Ei is the economic effect;
Si social effect;
Pi is the spatial effect;
Ri safety and resistance effect;
Gi is the environmental effect.

The maximum value of the integral indicator is 100 points.

For the calculation of the components of the integral indicator, the indicators were selected so that each of the five blocks reflects a corresponding dimension of the impact of an infrastructure project on territorial development. The selection of specific indicators is based on their ability to characterize the respective recovery effects, taking into account the availability and comparability of data at the level of territorial communities. At the same time, the limited availability or openness of certain analytical information at the local level may affect the composition of the indicator system and constitutes one of the methodological limitations of the proposed approach. Accordingly, changes in the set or individual indicators, as well as the application of alternative weighting or normalization schemes, may affect the results obtained, which determines the need for their further empirical testing. An example of the authors' multi-criteria priority-setting matrix is presented in Table 5.

Table 5. System of criteria and weighting factors

Code	Assessment Dimension	Indicator	Maximum Score
E1	Economic	Project impact on job recovery/creation	6
E2	Economic	Impact on local businesses and SMEs	6
E3	Economic	Potential to attract private investment	5
E4	Economic	Expected increase in local budget revenues	5
E5	Economic	Localization of economic effects within the community	3
		Total E	25
S1	Social	Number of residents gaining access to services	6
S2	Social	Impact on population return and retention	5
S3	Social	Improved access to education, healthcare, and social services	5
S4	Social	Impact on socially vulnerable population groups	4
S5	Social	Level of accessibility and inclusiveness of the facility	3
		Total S	23
P1	Spatial	Coverage of several settlements/starosta districts	5
P2	Spatial	Project significance for inter-settlement transport accessibility	4
P3	Spatial	Significance for the functional integration of the territory	4
P4	Spatial	Compliance with the Comprehensive Spatial Development Plan	3
		Total P	16

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R1	Security and Resilience	Critical importance of the facility for community life-support systems	7
R2	Security and Resilience	Degree of security risk reduction	6
R3	Security and Resilience	Availability of backup/autonomous operating systems	5
R4	Security and Resilience	Contribution to resilience against future shocks	4
		Total R	22
G1	Environmental	Energy and resource efficiency	4
G2	Environmental	Use of renewable energy sources	3
G3	Environmental	Reduction of emissions, pollution, and waste	3
G4	Environmental	Compliance with circular economy and green reconstruction principles	4
		Total G	14
		Total Maximum Score	100

Source: Developed by the authors

The weighting coefficients reflect the specifics of recovery in war-affected territories, where the economic, social, spatial, security and resilience, and environmental effects of infrastructure projects are considered as interconnected components of recovery. Given the multidimensional interpretation of Ukraine's reconstruction, according to which priorities should be determined with consideration of a range of challenges and the interrelationship between economic, security, and social dimensions (Protsak et al., 2025; Fedorenko, 2026), the weighting coefficients were determined by the authors as follows: E = 25%; S = 23%; P = 16%; R = 22%; G = 14%. The increased weight of the economic, social and security blocks is due to the specifics of the de-occupied and affected territories, for which the restoration of the viability of the local economy, basic services and the safe functioning of the territory are a priority. To ensure the uniformity of assessment, it is advisable to evaluate each indicator on a five-level scale, Table 6.

Table 6. Scale of uniformity of assessment

Impact Level	Share of the Maximum Score	Description
None	0%	The project has virtually no impact on the respective indicator
Low	25%	Localized or limited effect
Moderate	50%	Noticeable but territorially limited effect
High	75%	Significant impact on community functioning
Very high	100%	Systemic or strategic effect for the community

Source: Developed by the authors

Thus, if the maximum weight of the E1 indicator is 6 points, the actual score can be: 0; 1,5; 3,0; 4.5 or 6.0 points. This approach ensures a more consistent and comparable assessment of the effects of individual infrastructure projects and reduces the influence of subjective judgments in assigning scores.

Based on the results of the calculation, IP i infrastructure projects are proposed to be distributed according to five priority levels, Table 7.

Table 7. Priority Levels

IP_i, points	Priority Level	Managerial Interpretation
85–100	Critically high	The project is of the highest strategic importance and should be implemented as soon as possible
70–84.9	High	The project has a significant multiplier effect and should be included in the first implementation phase
55–69.9	Moderate	Implementation is advisable after critically important and high-priority projects
40–54.9	Low	Implementation depends on resource availability and requires additional justification
0–39.9	Very low	The project is not a priority or requires revision of its concept

Source: Developed by the authors

The obtained results are not only consistent with the contemporary understanding of the recovery of war-affected territories but also reveal an insufficiently explored aspect of the correspondence between infrastructure recovery and local economic development. The multi-criteria matrix represents their interaction as a comprehensive process that goes beyond the physical recovery of infrastructure facilities and encompasses economic, social, and spatial outcomes. At the same time, the proposed approach extends existing approaches to resilience, spatial recovery, and sustainable development by emphasizing the coherence between infrastructure recovery and local economic development as a distinct analytical dimension. It makes it possible to move from a general recognition of the interrelationship between infrastructure recovery and territorial development to its structured empirical assessment. In addition, the proposed methodological tools provide a basis for the practical validation of this logic. The comparison of infrastructure recovery outcomes with the dynamics of local economic development, combined with an assessment of the correspondence of reconstruction outcomes to these dynamics, can be carried out both at the level of individual infrastructure projects and within the investment portfolio of a community or territory.

The results of the practical application of the proposed approach are demonstrated using the example of an individual infrastructure project, namely a road rehabilitation project in the Ivankiv Rural Territorial Community of the Vyshhorod district of the Kyiv region, which connects settlements with the administrative center of the community (the village of Ivankiv), a hospital, and an industrial site, Table 8.

Table 8. Evaluation of the Road Rehabilitation Project to the Ivankiv Rural Territorial Community

Assessment Dimension	Score Obtained	Maximum Score
Economic Effect (E)	21	25
Social Effect (S)	19	23
Spatial Effect (P)	15	16
Security and Resilience Effect (R)	16	22
Environmental Effect (G)	8	14
Total IP	79	100

Source: Developed by the authors

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A score of 79 points corresponds to a high level of priority and indicates the feasibility of including such a project in the first stage of recovery.

At the ex-post stage after the implementation of projects, their effectiveness is evaluated through a change: the integral index of infrastructure recovery I_IR; the integral index of local economic development I_LED; the coherence coefficient K_C. Therefore, a completed evaluation cycle is formed: prioritization of the project → implementation → assessment of the infrastructure effect → assessment of the economic effect → determination of coherence → adjustment of subsequent investment decisions. For an even deeper ranking, it is advisable to offer a modified indicator:

$$IP^{c}_{i} = IP_{i} \times K_C,$$

where:

IPci adjusted integral priority indicator;

IPi initial 100-point assessment of the project;

K_C is the coefficient of coherence of infrastructural and local economic development.

So, if the project received: IP = 79 points, K_C = 0.85, then: IPc = 79 × 0.85 = 67.15 points. This means that even a project with a high potential effect can demonstrate lower actual performance if its implementation is not sufficiently consistent with the real pace of local economic development and the DREAM system.

The proposed matrix makes it possible to solve one of the key problems of infrastructure recovery the transition from the selection of projects mainly based on the criteria of physical damage and the cost of reconstruction to a multi-criteria assessment of their contribution to the restoration of the viability of the territorial community. Its fundamental difference is the simultaneous consideration of five groups of effects: economic - through employment, entrepreneurship, investment, and budget revenues; social - through the availability of services, population return, and inclusion; spatial - through territorial coverage, accessibility, and functional integration; security - through the criticality, autonomy, and resilience of infrastructure; environmental - through energy efficiency, decarbonization, and circularity. In this way, the proposed methodology provides a link between infrastructure restoration, local economic development and the achievement of sustainable development goals and can be used by local governments to form portfolios of restoration projects, comprehensive recovery programs, development strategies and medium-term public investment plans.

7. Conclusions

The study confirms that the restoration of the infrastructure of the de-occupied and affected territories of Ukraine should be considered not as a set of separate projects for the reconstruction of damaged facilities, but as a comprehensive tool for restoring the functionality of territorial communities, revitalizing the local economy and ensuring their long-term sustainable development. Infrastructure reconstruction forms the prerequisites for the restoration of entrepreneurial activity, employment and investment, the return of

the population, ensuring the availability of basic services, spatial integration and strengthening the financial capacity of local self-government.

The theoretical generalization made it possible to establish the cyclical-cumulative nature of the relationship between infrastructural and local economic development. The restoration of transport, energy, communal, residential, social and digital infrastructure improves the functionality and accessibility of the territory, reduces the costs and risks of economic activity, creates conditions for the return of business and the population, and stimulates investment. The intensification of economic activity, in turn, provides employment, incomes of the population and enterprises, expansion of the local tax base and growth of the financial capacity of the community, which creates resources for further infrastructural development.

On this basis, the concept of coherence of infrastructure restoration and local economic development is clarified, which is proposed to understand the degree of consistency of the direction, pace and results of infrastructure restoration with the dynamics of the main parameters of the local economy. This approach allows us to move from the traditional assessment of reconstruction by the number of restored objects and the amount of financial resources used to the assessment of its real contribution to the socio-economic transformation of the territory.

For empirical measurement of this interaction, it is proposed to form an integral index of infrastructure recovery (I_IR), an integral index of local economic development (I_LED) and a coefficient of their coherence (K_C). At the same time, it is proved that a high level of formal coherence does not necessarily characterize the success of recovery, since two low integral indicators can be close. Therefore, K_C should be interpreted together with the absolute levels of I_IR and I_LED, as well as with the directions and rates of their change.

The practical result of the study is the proposed author's 100-point matrix of prioritization of infrastructure projects, which provides for the assessment of 20 indicators in five blocks: economic (E), social (S), spatial (P), security and resilience (R) and environmental (G). The setting of weights E = 25%, S = 23%, P = 16%, R = 22% and G = 14% takes into account the specifics of the de-occupied and affected territories, for which economic recovery should be combined with meeting the basic needs of the population, restoring territorial accessibility, security and environmental sustainability.

The proposed matrix allows us to change the logic of prioritization from the principle of "first restoring the most damaged" to the principle of "restoring first what provides the greatest cumulative effect for the functioning and sustainable development of the territory". This is especially important in the context of limited financial resources and a significant amount of needs for the reconstruction of Ukraine.

The methodological approach involves the formation of a closed cycle of performance management: identification of the need → the formation of a project → ex ante evaluation according to the E–S–P–R–G matrix → prioritization → inclusion in the portfolio of public investments → financing and implementation → monitoring → ex post evaluation of I_IR, I_LED and K_C → adjustment of subsequent investment decisions. This model allows you to combine the project and territorial levels of recovery assessment.

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An important result is also the identification of five priority areas for strengthening the effects of infrastructure reconstruction. The economic direction involves maximizing the impact of infrastructure investments on entrepreneurship, employment, private investment, and the local tax base. Social - ensuring the availability of basic services, the return and consolidation of the population, inclusiveness and barrier-free. Spatial - the formation of a backbone infrastructure network, improving inter-settlement accessibility and reducing territorial disparities. Security - the integration of humanitarian demining, autonomy and resilience of critical infrastructure. Environmental - implementation of the principles of energy efficiency, decarbonization, resource efficiency, and circular economy.

Therefore, the sustainable development of the de-occupied and affected territories requires a transition from object-oriented reconstruction to territory-oriented sustainable recovery, within which an infrastructure project is evaluated not only by the fact of its physical implementation, but primarily by its ability to create measurable economic, social, spatial, security and environmental effects.

It is advisable to integrate the practical implementation of the proposed approach with the functioning of the Digital Restoration Ecosystem for Accountable Management (DREAM). DREAM creates a digital environment for the management of public investment and recovery projects, which makes it possible to use the proposed system of criteria at different stages of the project cycle. In this context, the author's matrix can act as an additional analytical tool ex ante for evaluating and ranking projects included in the digital ecosystem according to their potential economic, social, spatial, security and environmental effects.

The combination of DREAM with the proposed methodology creates prerequisites for the transition from digital accounting of recovery needs and projects to data-driven prioritization, when the priority of funding is determined not only by the cost, degree of readiness or physical condition of the facility, but also by the expected contribution of the project to the comprehensive restoration of the territorial community. Accordingly, information on projects and their implementation can be used to form an initial database for calculating individual indicators of the proposed assessment system.

The scientific novelty of the study lies in combining ex ante multi-criteria prioritization of infrastructure projects with ex post assessment of infrastructure recovery outcomes, local economic development, and their coherence. The proposed approach extends the traditional object-oriented understanding of territorial recovery by considering infrastructure investments in relation to economic, social, spatial, and other effects on territorial development. The use of data from the DREAM digital ecosystem in combination with the proposed assessment framework creates opportunities for more transparent, scientifically grounded, and effective management of public investments in the recovery of territorial communities

The practical significance of the results lies in the possibility of using the proposed approach by local governments, public authorities and other recovery entities in the formation of comprehensive recovery programs, strategies for the development of territorial communities, medium-term plans for priority public investments and portfolios of investment projects, as well as in justifying the priority of financing projects in the DREAM digital ecosystem. The integration of the proposed assessment framework with

DREAM may provide an additional analytical basis for more transparent and evidence-based planning of recovery investments.

Future research should focus primarily on the extended empirical validation of the proposed E–S–P–R–G matrix and the coherence coefficient using a sample of de-occupied and war-affected territorial communities in Ukraine that differ in terms of recovery conditions and levels, economic structure, security context, and demographic characteristics. Further use of DREAM data and official statistics may enable the formation of panel datasets for statistical analysis of the relationships between infrastructure recovery and local economic development, including consideration of possible time lags.

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