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INFRASTRUCTURE AND SERVICE METHODOLOGY FOR THE DEVELOPMENT OF INNOVATIVE HROMADAS: GENERAL IDEA AND EXAMPLE OF SMART CITY INFRASTRUCTURE

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Abstract. *The purpose* of the study is the development of analytical tools and organizational and economic mechanisms for the post-war restoration of sustainable development of territories based on the infrastructural and service methodology of the development of innovative hromadas as a basis for ensuring the well-being of local hromadas to avoid the social, environmental and economic problems of war and their approval within the framework of pilot infrastructural and service projects. *Methodology*. The research is based on the approach of R. Jochimsen, who, in one of the first system descriptions, defined infrastructure as a set of material (production), institutional and individual conditions available to economic agents, which condition integration and the maximum level of economic activity. It is also worth considering the idea that the main differences of the neo-industrial paradigm of local hromada development lie in competent participation based on self-organization, multisubjectivity and decentralization of social relations based on cooperation and communicative equality, and the orientation of society towards the realization of human potential. Innovative hromadas correspond to these trends and provide an effective solution to the primary task of the service-oriented system, which consists in the development of a service policy capable of ensuring the inclusion of existing resources and functional potential of territories to ensure dynamic, balanced, complex socio-economic development. The infrastructure-service approach includes the maximum satisfaction of human needs and desires, as well as the creation of working and living conditions, and aims to meet the needs of the hromada by attracting and retaining human resources through the development of services and infrastructure. *Practical implications.* The results of the research have applied socio-economic significance and are aimed at solving the important problem of post-war restoration of sustainable development of territories through the design of service provision and use of resource potential of local innovative hromadas. The main result of the application of the developed methodology is the scientific substantiation of the organizational and economic support for the post-war restoration of the sustainable development of territories based on the infrastructure-service methodology of the development of innovative hromadas and the development of the corresponding analytical toolkit, which will allow its adaptive use within the framework of intelligent specialization. Scientific and methodological approaches will be developed to determine the role of infrastructure and service clusters for the well-being of hromadas, based on a consideration of their impact on human capital and its components. *Value/originality.* Compared to existing analogues, the proposed approach is systemic, takes into account the specifics of innovative activity and covers the entire range of tasks for managing infrastructure and service factors of sustainable development.

Key words: infrastructural and service methodology, innovations, infrastructure, smart city, project.

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1. Introduction

In the conditions of decentralization and transition to new principles of management, the issue of sustainable development of hromadas is a relevant and important direction of interdisciplinary research. It is necessary to note that in connection with the military actions in the hromadas of a number of regions, cardinal economic and social changes are taking place, which quite often have the character of socio-economic instability.

The purpose of the study is the development of analytical tools and organizational and economic mechanisms for the post-war restoration of sustainable development of territories based on the infrastructural and service methodology of the development of innovative hromadas as a basis for ensuring the well-being of local hromadas to avoid the social, environmental and economic problems of war and their approval within the framework of pilot infrastructural and service projects.

The results of the research have applied socio-economic significance and are aimed at solving the important problem of post-war restoration of sustainable development of territories through the design of service provision and use of resource potential of local innovative hromadas.

2. Literature review

A number of studies by domestic and foreign scientists consider the role of the innovation factor in the development of regions and local hromadas.

In particular, the study (Tödtling, Trippl, 2018) is devoted to the development of a management methodology for "new paths of regional growth", which should take into account the local context. The authors (Frangenheim, Trippl, Chlebna, 2020) determine the prospects of regional structural changes and develop the basis for the analysis of the dynamic interdependence of new regional growth paths. The study (Martin, Simmie, 2008) examines the local innovation system in combination with the ability to absorb new knowledge. The study (Hansen, 2013) examines the development of regional innovation systems in the context of the search for their foundations.

Thus, the paper (Domanski, Howaldt, Kaletka, 2020) considers social innovation as a factor in successfully solving social, economic, political and environmental challenges at the local and regional level.

The authors (Grillitsch, Martin, Srholec, 2017) consider the combination of the most favorable innovations at the firm level, taking into account the impact of the knowledge base available in the region.

The study (Asheim, Grillitsch, Tripple, 2017) points to the role of economic geography in providing a better understanding of the mechanism of economic growth and development in different sectors and regions, as well as a better understanding of the consistent heterogeneity of regional outcomes. These approaches and ideas can be the basis for a large-scale approach to innovation policy and the active role of government in stimulating new combinations of differentiated innovations. At the same time, the analysis of these studies makes it possible to conclude that they are focused on developed countries, but in the conditions of Ukraine, innovation policy should be focused primarily on overcoming numerous crisis processes.

In this regard, it is worth noting the work (Yevsyukova, 2018), which considers the well-being factor and states that human capital is determined by natural genetic characteristics, developed by education and general education, and its success (competitiveness) depends on ecological, economic and material well-being, economic and legal institutional conditions, adequate stimulation and the level of a specific qualification, which constitute a socio-ecological-economic system in a relative current equilibrium. In the work (Tarkhov, Derkach, 2013) it is noted that human capital includes health capital, cognitive and creative capital, entrepreneurial capital, qualification capital.

The study (Mokii, Pavlikha, Naumenko, Datsko, 2018) presented a scientific and theoretical justification for institutional support of innovative regional development, which should be based on the idea of a hromada as a social system.

At the same time, little is known about the innovative profiles of different infrastructure sectors of the economy and the nature of their innovative activities, and a targeted approach to defining service design and the methodology of its implementation has not yet been developed.

3. Methodology

The research is based on the approach of R. Jochimsen (Jochimsen R. Theorie der Infrastruktur), who in one of the first system descriptions defined infrastructure as a set of material (production), institutional, individual conditions available to economic agents, which condition integration and the maximum level of economic activity.

From an applied point of view, for the purposes of research in the context of post-war reconstruction, the approach of the experts of the Institute of Infrastructure Policy will be adapted, in the framework of which vital infrastructure is defined as systems, networks, objects, resources (both physical and virtual or information), services, which are of such great importance that their destruction, damage or disabling will lead to the most serious negative consequences for the life of a person, society and the state, socio-economic development of the country, defense capability of the state and ensuring national security.

It is also worth considering the idea that the main differences of the neo-industrial paradigm of the development of local hromadas lie in the competent participation based on self-organization, multi-subjectivity and decentralization of social relations based on cooperation and communicative equality, and the orientation of society towards the realization of human potential. The innovative hromadas correspond to these trends and provide an effective solution to the primary task of the service-oriented system, which consists in the development of a service policy capable of ensuring the inclusion of the existing resources and functional potential of the territories, in order to guarantee a dynamic, balanced and complex socio-economic development.

The infrastructure-service approach includes the maximum satisfaction of human needs and desires, as well as the creation of working and living conditions, and aims to meet the needs of the hromada by attracting and retaining human resources through the development of services and infrastructure.

Therefore, it is advisable to focus on the adaptation of the management of the development of innovative hromadas to the problems of sustainable development as such, which opens opportunities for the study of promising organizational and economic mechanisms of service-oriented management, based on the assessment of the impact of changes in the state as a result of military operations in the economic space and its effects on the quality of life, vital space and human capital.

It is important to take into account the ideas and methodology of the geography of innovation, which combines the methods of economic geography, regional economy and innovation and examines the spatial patterns of creation, implementation and distribution of new ideas, technologies, products, as well as the impact of these processes on regional (local) development. From these points of view, the infrastructure-service approach is relevant because it is based on the potential of territories and aims at a more intensive use of their capabilities.

4. Main material

The research is based on the infrastructure and service methodology of the development of innovative hromadas, which implies the understanding that innovations include not only technological changes, but also changes in organizational, labor and social practices as such, which can potentially affect the well-being of the human capital of hromadas.

Service modeling involves the description of all processes in hromadas of different typologies in order to take these processes into account during design.

Infrastructure and service design is a process of organizing space in such a way that the interaction of economic agents within innovative hromadas takes place as smoothly and efficiently as possible. In this context of the project, service innovation at the local level is considered as an integration set of basic factors of standard of living, socio-economic conditions, characteristics of innovative business units, innovative infrastructure, cluster and network connections.

For the development of infrastructure at the local level, it is necessary to use the existing potential of the hromada as much as possible, which can be done most effectively through the development of innovative hromadas.

Development at the regional level should be carried out through a combination of smart specialization strategies and sustainable development tasks. Based on the understanding of the impact of military operations on

sustainable development goals, the project uses a methodological approach to determine the loss of human capital and ensure the environmental and economic well-being of hromadas based on consideration of their role for human capital and its components (health capital; cognitive and creative capital; capital of entrepreneurial abilities; qualification capital).

For the implementation of pilot infrastructure and service projects, it is proposed to use the toolkit of sub-outsourcing cooperation, which is based on the implementation of the principle of commercial partnership and can manifest itself in the form of support for various areas of commercial support, sectoral support of a single project, distribution of service flows between outsourcing partners, integration of joint resources to solve a single task, which can ensure the use of the potential of innovative hromadas.

Experts from the INSEAD business school note that the government of Ukraine during the recovery "should work for the people, and the corresponding infrastructure (housing, transport, hospitals, schools) should be a priority". The EU's strategic plan for post-war reconstruction of Ukraine, "Rebuilding Ukraine", notes the important role of the infrastructure factor, which should be restored according to the principle of "doing better than it was". The draft recovery plan of the Government of Ukraine provides for the reconstruction of the entire infrastructure, including medical and educational facilities, as well as strategic enterprises that were destroyed or partially damaged.

The analysis of the results of the survey conducted by the Razumkov Center in 2021 among the representatives of local self-government bodies on the principles, conditions and feasibility of implementation of intelligent infrastructure in the cities of Ukraine makes it possible to note that even before the military operations, the highest priority was the expansion of services for city residents in the field of health care, social security, education, transportation, housing and public services, etc. It is worth mentioning a number of initiatives, for example, the program of the President's Office "New Village", according to which 1,600 infrastructure projects are planned to be implemented in a new format of interaction between the state, local authorities, business and the hromada on the basis of private-state partnership.

The role of the infrastructural factor can be confirmed by the norms of the Law of Ukraine "On National Security of Ukraine", which defines that the fundamental national interests of Ukraine include the sustainable development of the national economy, civil society and the state to ensure the growth of the level and quality of life of the population by ensuring the security of vital for society and persons of interest.

UNDP experts in Ukraine also presented a project aimed at supporting pilot territorial hromadas in issues of updating local development strategies and approval of the monitoring and evaluation tool in the conditions of post-war reconstruction and development. From these positions, the proposed study is relevant and aimed at solving the important task of post-war reconstruction.

Thus, compared to existing analogues, the proposed approach is systemic, takes into account the specificities of innovative activity and covers the whole range of tasks for the management of infrastructure and service factors of sustainable development.

5. Smart city case

Despite the significant potential of the proposed methodology, the question of its practical implementation arises. One of the options for solving this problem is related to the creation of an area with a high concentration of human capital and innovation – smart cities.

Smart cities are based on a combination of human capital (skilled workforce), infrastructure capital (e.g., high-tech communications), social capital (such as an intensive and open communications network), and entrepreneurial capital (for example, creative and entrepreneurial activities).

A smart city is a city built on the principles of sustainable development, a city where modern technologies are used for more efficient and sustainable management, a city with a high quality of life that contributes to the development of its human capital.

Smart cities are high quality of life cities that strive for sustainable economic development through investment in human and social capital, traditional and modern IT infrastructure, and participatory natural resource management.

Smart cities are about using digitalization to create future-ready, self-optimizing, sustainable urban hromadas where people want to live, work, and learn. They provide an environment that improves the lives of everyone: residents, businesses, students and faculty, and visitors. At the same time, a smart city is efficient, resilient, and minimizes environmental impact.

Smart technologies offer a wide range of solutions for reformatting the infrastructure of cities with new approaches to energy supply, mobility development and the urban economy in general, in order to reduce emissions by ensuring an appropriate level of energy efficiency and decarbonization of energy supply.

Main components of Smart infrastructure are shown in Table 1.

Table 1
Main components of Smart infrastructure
(Commission on Science and Technology for Development, 2016)

Smart infrastructure component	Main idea	Practical implications
Smart buildings	Smart buildings intelligently integrate the various physical systems present to ensure that all systems work together in an optimized and efficient manner.	Intelligent building management systems can improve a building's energy efficiency, reduce waste, and ensure optimal water use, while increasing operational efficiency and resident satisfaction.
Smart mobility	Smart mobility is best described as approaches that reduce congestion and promote faster, greener, and cheaper transportation options. Most smart mobility systems use data collected from a variety of sources about mobility patterns to help optimize traffic conditions in a holistic way.	Intelligent mobility systems include mass transit systems as well as individual mobility systems that include bike sharing, ride sharing (or carpooling), vehicle sharing, and more recently, on-demand transportation.
Smart energy	Smart energy management systems use sensors, advanced meters, renewable energy sources, digital controls, and analytical tools to automate, monitor, and optimize the distribution and use of energy. Such systems optimize grid operations and usage by balancing the needs of the various stakeholders involved (consumers, producers, and providers).	There are a number of smart energy infrastructure innovations, such as distributed renewable generation, microgrids, smart grid technologies, energy storage, automated demand response, virtual power plants, and demand-side innovations such as electric vehicles and smart appliances. Such innovations provide an extended network of smart energy devices across a city, with a detailed view of energy consumption patterns, enabling community-based energy monitoring programs and improving the energy efficiency of buildings.
Smart water	Cities are constantly trying to solve water scarcity problems with innovative technologies and better water management. Improved metering and flow management are key to a good water distribution system.	A smart water management system uses digital technology to help conserve water, reduce costs, and increase the reliability and visibility of water distribution. Physical pipe networks are overlaid with data and information networks. The system typically analyzes available flow and pressure data to identify anomalies (such as leaks) in real time to better manage water flow. Customers can be provided with real-time information on the water situation and relevant information to help conserve water, resulting in lower water bills.
Smart waste management	Waste generation is growing faster than urbanization. Cities are finding it increasingly difficult to source, separate, and utilize different types of waste that can potentially be returned to a consumer's life cycle.	Waste management typically involves the monitoring, collection, transportation, processing, recycling, and disposal of waste. Intelligent waste management systems reduce waste, categorize the type of waste at the source, and develop methods for proper waste management. Such systems can be used to turn waste into a resource and create closed-loop economies. Their primary benefits lie in improving the efficiency of waste collection, segregation, separation, reuse and recycling.

(End of Table 1)

Smart infrastructure component	Main idea	Practical implications
Smart health	The health and well-being of urban populations is of particular concern for the sustainability of urban areas and their supporting ecosystems. Smart cities can develop the capacity to use technologies such as big data to develop predictions or identify hotspots of population health (such as epidemics or health impacts during extreme weather events). Smart health management transforms health-related data into clinical and business insights, including digital health records, home health services, and remote diagnosis, treatment, and patient monitoring systems. It also facilitates the delivery of healthcare through intelligent and connected technologies that help monitor the health of citizens. It enables a shift in focus to prevention rather than cure, with a broader view of total care, healthy living and wellness management. Smart health systems have great potential in the aging societies of developed countries and can reduce inequalities in health care between high- and low-income groups.	Examples of smart health approaches include crowdsourcing to collect data on epidemics and predict outbreaks and take necessary precautions, remotely collecting patient vital signs and data for diagnostic purposes, and setting up automated alerts for patients regarding medications and health check-ups. In Africa, for example, the Medic Mobile project in rural areas uses locally available mobile technology to help health workers report symptoms to the nearest clinic, receive treatment advice and emergency referrals, and provide information on the prevalence of disease burden in a village or hromada.
Smart digital layers	Smart digital infrastructure helps to better understand and control operations and optimize the use of limited resources in a city. One of the key value propositions of ICT in a smart city is the ability to collect and share information in a timely manner. When information is provided in real time and is accurate, cities can potentially take action before a problem escalates.	One way to think about digital infrastructure is in terms of different supporting digital layers, as follows: (a) Urban: The layer where physical and digital infrastructure meet. Examples include smart buildings, smart mobility, smart grids (for utilities such as water, electricity, and gas), and smart waste management systems. (b) Sensor: This layer includes smart devices that measure and monitor various parameters of the city and its environment. (c) Connectivity: This layer includes the transport of data and information from the sensor level to storage and data aggregators for further analysis. (d) Data analysis: This layer involves the analysis of data collected by various smart infrastructure systems to help predict certain events (such as traffic congestion). (e) Automation: The digital interface layer that enables automation and scalability for a large number of devices across multiple domains and verticals.

6. Practical implications

The results of the research have applied socio-economic significance and are aimed at solving the important problem of post-war restoration of sustainable development of territories through the design of service provision and use of resource potential of local innovative hromadas.

The scientific and methodological bases of building innovative hromadas within the framework of the concept of sustainable development can be used to solve the strategic planning of infrastructural development of regions in the context of neo-industrial modernization.

The results of the project also have a distant socio-economic impact, which consists in the effort to solve the national and global problem of maintaining and strengthening the well-being of hromadas, especially the health of the population, preventing the loss of human capital due to the influence of the military factor.

On the basis of the developed methodology, it is possible to develop proposals for the management of resources for the development of territories from the point of view of the formation of an infrastructure and service base (1) for the development of production (financing of innovative infrastructure projects of industrial parks, formation of "growth points of Industry 4. 0", clusters, development of financial infrastructure (leasing)); (2) innovation – for financing innovative projects for creation of innovative infrastructure: business incubators, IT industry sector, R&D in medium-term priority scientific and technical areas of regional development; (3) social development – for implementation of innovative projects in the field of education, health care, modernization of housing and communal services, recreation.

7. Conclusions

The main result of the application of the developed methodology is the scientific substantiation of the organizational and economic support for the post-war restoration of the sustainable development of territories based on the infrastructure-service methodology of the development of innovative hromadas and the development of the corresponding analytical toolkit, which will allow its adaptive use within the framework of smart specialization. Scientific and methodological approaches will be developed to determine the role of infrastructure and service clusters for the well-being of hromadas, based on the consideration of their impact on human capital and its components (health capital; cognitive-creative capital; entrepreneurial skills capital; qualification capital).

Based on the definition of the problems of human capital formation, it is possible to develop a scientific and methodological approach to determine the optimal scenario for the formation of public-private partnerships in the context of scenarios for the development of infrastructure-service clusters and a platform approach to the accumulation of social capital in innovative hromadas, and their experimental approval was carried out.

According to the results of the review of the best world experiences and in order to improve the development of smart specialization strategies, it is possible to prepare practical recommendations for the adaptive development of service (soft) infrastructure in hromadas in the context of post-war recovery (e-commerce and e-business infrastructure (e-contracting, e-invoicing, e-logistics); life support infrastructure (digital medical, educational, transport, logistics and other systems, public safety systems); geo-information infrastructure (linking digital data to spatial objects); industrial digital infrastructure (Industry 4.0).

An important result will be the theoretical and methodological foundations of the analytical approach to justify the choice of infrastructure and service elements to ensure the well-being of hromadas, based on the identification of the main social, environmental and economic problems that have arisen as a result of military operations.

On the basis of the research results, appropriate spatial planning tools, infrastructure trends, new services, and human-centered methodologies and approaches to the design of technical and social solutions in modern cities will be identified.

The research will develop pilot infrastructure and service projects and identify appropriate infrastructure and service clusters for their implementation. The specified projects will be based on the key principles of the service economy (the principle of customer relations between citizens and authorities, the principle of competitiveness of public services, the principle of independent assessment of the quality of public services, the principle of optimization of the technological chain of public services) and will be oriented to the key tasks of post-war reconstruction. Key aspects of infrastructure and service design will be identified for each project developed: responsiveness to needs (latent or explicit); high value to the consumer: provision of a new service, benefit or function or its provision in an improved form; quality of provision of a new service; technological synergy.

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