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Problem of restoring the reproduction
of housing stock in a complex emergency
situation

Introduction. The paper reveals the main theoretical and methodological aspects of the formation and develop-
ment of management methods for construction and restoration work in a complex emergency situation (CES).
The paper considers modern principles and practices of the federal state programme for the support of liberated
regions, which require adaptation and synchronization of production and investment planning to overcome crisis
phenomena in the housing sector.

Materials and methods. The object of the study is a management system for restoring the reproduction of urban
housing stock and the quality of the urban environment in Donbass and Novorossiia. It is indicated that the res-
toration of the housing stock in CES conditions is a complex, limited in resources, time and territory process that
requires adjustments, improvements and updates of regulatory, technical, social and economic provisions in or-
der to stimulate the revival and sustainable development of liberated regions. The author's paradigm of scientif-
ic and technological support of investment and production processes is proposed, including flexible planning and
problem-oriented management of spatial and resource development of urban real estate.

Results. Based on the structuring of the problem space of damage and destruction of housing stock, a scenar-
io approach to modeling territorial multifunctional complexes and updating cluster development territories is pro-
posed. Resource-intensive, motivational and balanced situational models are substantiated, allowing for the co-
ordination of construction and restoration work in the life cycle system of urban real estate revitalization and
redevelopment.

Conclusions. The theoretical and methodological substantiation of the principles of the construction and resto-
ration works management system makes it possible to redistribute resources, identify hidden opportunities and
ensure the sustainability of the implementation of programme goals in the restoration of urban real estate repro-
duction in conditions of uncertainty and CES risks.

Keywords: reproduction of housing stock, emergency situations, urban environment, scientific and technical
support, problem-oriented management, revitalization, life cycle, redevelopment

INTRODUCTION

The implementation of the tasks of the state pro-
gramme "Restoration and socio-economic de-
velopment of the Donetsk People's Republic,
Luhansk People's Republic, Zaporizhia region and
Kherson region" requires the formation of organiza-
tional and technological management models and
coordination of construction and restoration work, al-
lowing to offset the negative consequences of
a complex emergency situation¹. Reproduction pro-
cesses within the framework of urban planning activ-
ities include the entire complex of repair and recon-
struction measures in the life cycle of a real estate
object: current repairs, major repairs, modernization,
reconstruction, restoration, renovation and improve-
ment of the urban environment in accordance with
modern safety and comfort requirements [1].

Housing reproduction is an economic activity
aimed at stimulating social production, attracting
significant investment and capital growth, forming
regional priorities for spatial and resource real es-
tate development and creating an appropriate level
of urban environment quality [2, 3]. It is necessary

to systematize the results of multidimensional re-
search, problem-oriented to identify resource-orga-
nizational elements:

- development of the theory of sustainability of
reproductive processes in the investment,
construction, housing and communal servic-
es in the market [4];
- regulatory and legal framework of organiza-
tional and managerial aspects as a system for
regulating the transformation of property rela-
tions and the development of the real estate
market [5, 6];
- strategies for the reproduction of housing
stock in the post-crisis period in conditions of
limited resources during new construction,
restoration and maintenance of facilities, tak-
ing into account premature wear [7, 8];
- system for regulating the development of in-
novative activities in the field of construction
and reconstruction of housing stock, reflect-
ing market statistics and markets in the invest-
ment and construction sector [9, 10];
- influence of technical, technological, eco-
nomic, social, urban planning, sanitary, envi-
ronmental, historical, architectural and other
factors [11, 12];
- strategies and tools for the formation of territo-
rial systems of constantly renewable process-
es of production, distribution, consumption

¹ The State programme "Restoration and socio-economic de-
velopment of the Donetsk People's Republic, Lugansk People's Repub-
lic, Zaporizhia region and Kherson region". URL: [https://постановле-
ние-правительства.рф/gosudarstvennaya-programma-vostranovle-
nie-i-sotsialno-ekonomicheskoe-razvitie-doneczkoj-narodnoj-respub-
liki-luganskoj-narodnoj-respubliki-zaporozhskoj-oblasti-i-hersonskoj-
oblasti/](https://постановле-
ние-правительства.рф/gosudarstvennaya-programma-vostranovle-
nie-i-sotsialno-ekonomicheskoe-razvitie-doneczkoj-narodnoj-respub-
liki-luganskoj-narodnoj-respubliki-zaporozhskoj-oblasti-i-hersonskoj-
oblasti/)

and exchange of housing based on the risks of supply and demand [13, 14];

- sustainability and long-term balanced development of territorial reproduction systems of the development business based on strategic focus and synchronization of investment, production and financial activities, taking into account the tasks of territorial and sectoral development [15, 16];
- revitalization in the field of construction, planning, economics and social policy of urbanized territories in a complex emergency situation (CES) [17–19];
- overcoming the degradation consequences of real estate related to the deterioration of the life cycle of operational indicators of technical condition in terms of reliability, operational suitability and quality of life [20];
- formation of information-commutative opportunities for the promotion of innovative and investment solutions for the restoration of reproduction in the housing sector [21, 22].

It is known that when restoring housing and urban infrastructure, special attention must be paid not only to the renovation and replacement of real estate objects that are being disposed of as a result of physical and moral deterioration, but also to the economic development of methods for managing existing resources in accordance with changing information, technological, environmental and social needs. The result of many years of generalization of the global experience of housing rehabilitation in emergency situations caused by post-crisis events and natural disasters is a guidance document in the field of planning and implementation of large-scale technical assistance [23].

Analysis of research results and publications of works [2, 7, 8, 13, 15, 19] He points out the need to distinguish between the concepts of “reproduction” and “restoration of reproduction”, which is due to problematic issues of programmatic measures aimed at eliminating the consequences of CES during a local military conflict.

The purpose of the paper is to substantiate and develop methodological provisions of a strategy for problem-oriented management of spatial and resource development in the restoration of housing stock reproduction and urban environment quality based on institutional mechanisms and a flexible planning system in Donbass and Novorossiia.

The restoration of housing reproduction is a complex, coordinated, limited in resources, time and territory process of regulatory, technical, social and economic changes initiated in order to stimulate sustainable development in the liberated historical regions of Russia.

The housing stock, as a renewable resource of urban real estate, functions in a unity of social, economic, material and legal circumstances caused by a set of interrelated stages of creation and successive changes in technical condition, the needs of growing competition and changing market requirements. Thus, the principles of flexible planning of the resource base for new construction, modernization, reconstruction, renovation, revitalization and redevelopment for the reconstruction of renovated urban real estate are the basis of the strategy for restoring housing reproduction and improving the quality of the urban environment in CES conditions.

The following tasks are considered as the priorities of this study, forming a strategy for restoring reproduction and socio-economic development of Donbass and Novorossiia in the housing sector:

- analyze the features of flexible planning and management of reproduction processes during construction and restoration work;

- substantiate a problem-oriented approach to the renewal of cluster territories in the urban real estate revitalization life cycle system;
- develop information and switching support for the cluster of the project “Promotion of digital technologies and platform solutions for managing the lifecycle of real estate objects based on parametric regulation of target criteria for quality, reliability and safety”.

Housing is the foundation for sustainable development and meeting basic human needs. In CES conditions caused by various combinations of political, economic, environmental, conflict factors and crisis phenomena, housing is the most important component of the total damage resulting from damaged or completely destroyed many thousands of construction sites. The use of flexible planning and problem-oriented management methods opens up additional opportunities for the theoretical and methodological formation and development of organizational models for construction and restoration work, which can significantly increase the sustainability and profitability of urban real estate.

MATERIALS AND METHODS

The study of the housing reproduction management system is becoming acutely relevant in connection with the structuring of the problem space of restoration, construction and development of housing real estate funds in large cities of Donbass and Novorossiia. The restoration of housing reproduction in CES conditions has many more aspects than new construction or reconstruction in an existing building [24]. This applies, first of all, to the need to adapt the regulatory framework for construction, the development of a state strategy, approaches to restoration, spatial and resource development of urban real estate, including monitoring, assessment, quality assurance and risk management systems. The multifactorial nature and high degree of uncertainty of investment and construction processes during the restoration of reproduction in CES conditions undoubtedly increases the risks when compared with investment projects in the field of housing stock reproduction in the post-crisis period. Thus, the realization of the purpose and objectives of this study is determined by the effectiveness of flexible planning and problem-oriented management as tools of the organizational and economic mechanism of government authorities, building customers with the participation of scientific and public organizations, professional associations and the population in the restoration of reproduction of urban real estate funds.

The federal state programme to support the liberated regions² includes the restoration of housing, communal and transport infrastructure, the development of the social sphere, the creation of a favorable investment climate and the achievement of average Russian quality of life indicators by 2030. The set goals will be achieved through direct government support from the federal budget, as well as through the growth of entrepreneurial activity. Subsidies are provided for the development of housing construction, the completion of the construction of multi-family residential buildings, the developers or owners of which have not been identified, and the formation of a modern urban environment. The subsidy funds will be allocated on a co-financing basis. An important tool for investor support will be the development of a free economic zone created in new regions³.

² URL: <http://government.ru/docs/50567/>

³ URL: <https://www.kp.ru/money/lichnye-finansy/lgotnaya-ipoteka-dlya-novykh-regionov/>

► The PPP Law⁴ defines public-private, municipal-private partnership as cooperation, within a specified period, by pooling resources, distributing risks in order to attract private investment into the economy, ensuring the availability of goods, works, and services by public authorities and local governments and improving their quality. Starting in 2023, a programme of housing loans with state support is being implemented. The preferential mortgage for the recipient in the new regions is only 2 %, with an additional payment from the state to banks on market terms⁵.

Government support measures for small and medium-sized businesses include preferential loans, preferential leasing, the operation of "My Business" centres, social and technical consultations on business activities, product promotion and sales, etc. This allows entrepreneurs to receive preferential microloans and guarantees to attract credit funds⁶. At the territorial level, a draft pilot programme has been developed for the restoration of private housing in municipal and urban districts through the use of ready-made housing kits. Factory-made building structures and products are intended for the prefabricated construction of individual housing.

The multilevel management system in the field of housing stock restoration is based on the theoretical and methodological basis of research in the field of investment and construction activities of residential real estate, management decisions and risk management theory, as well as the patterns of behavioral economics. The author's hypothesis of this work reveals the methods of problem-oriented management of cycles of sustainable development of the territorial spatial and resource development of the building complex, allowing to offset the negative effects of CES. For this purpose, the organizational and technological principles of the cluster model for the restoration of viable housing and a comfortable urban environment, balanced indicators of innovation and investment attractiveness and business mobility, adaptive mechanisms of technical and economic protection in conditions of uncertainty and risk, as well as information modeling of the life cycle of urban real estate objects are used.

Problem-oriented management includes the adaptation of the principles, methods and formats of synchronization of production and investment planning to the basic requirements of construction and restoration work to renovate the cluster territory in the context of the revitalization of the existing urban development. Problem-oriented management allows an enterprise to quickly respond to changes in the external and internal environment, as well as to optimize its resources.

Special attention is paid to the models of software solutions for the formation of a management structure and flexible planning in conditions of uncertainty of various factors of the internal and external environment. Flexible planning makes it possible to effectively manage construction and restoration work, which is especially important in conditions of limited resources and time. Following the principles of adaptability, priority of tasks, continuous improvement and openness, a situational scenario approach is applied that takes into account the initial possibilities of restoring the cluster-territory through renovation, resource base and housing and communal services, investment attractiveness of real estate revitalization and redevelopment projects. For this purpose, the MoSCoW methodology is used, which helps to prioritize critical (Must), desirable (Should), possible (Could) and deferred (Won't) tasks, taking into account

plans for the implementation of investment programs for the restoration, reconstruction and development of urban real estate.

The described approaches are implemented using a set of initial data for a variant justification of the project goals of sustainable development:

Scenario-based approach to the study of promising solutions. Several alternative strategies (scenarios) for the development of the system (object) in question over time are being developed. Scenarios can be based on the predicted possible situations mentioned above. The combination of scenarios and the presence of critical points is a possible range of reasonable solutions to the problem. Scenarios are developed independently from each other. For each of them, a complete list of the most important indicators is calculated (criteria, volumes of finished construction products, various economic indicators, necessary material, energy and labor resources, environmental impacts, consumer basket of the population, etc.). Scenarios are not rejected without special reasons; their comparison and analysis are carried out for all the most important indicators.

"Rocking constraints" involves analyzing the stability of a solution in relation to specified constraints. Almost always, when restrictions on resources and on the volume of finished construction products are introduced into the model, the magnitude of the restrictions cannot be accurately predicted for the long term. In these cases, after finding the optimal option for the initially set constraints, you should begin to consistently "swing" them, changing the constraints up or down with a certain step within reasonable limits. For each combination of numerical constraints, the optimal variant is found (according to the same model). Next, the stability of the system's results is analyzed in relation to the magnitude of each of the constraints. The analysis makes it possible to identify a reasonable range of restrictions for the purpose of effective implementation of investment projects.

Varying the criterion involves analyzing the stability of the solution based on the results of parametric programming. It makes it possible to determine the stability intervals of the optimal solution for all parameters of the objective function, as well as to find optimal production plans for deviations in the parameters of the objective function that violate the boundaries of the stability intervals of the solution.

RESULTS

The priority of restoring the reproduction of housing stock and urban renewal is their harmonious and multifaceted development by properly adapting existing resources to current needs.

Taking into account the conditions of CES, three calculated scenarios for modeling the development of the housing stock of the territorial multifunctional complex (TMFC) have been identified:

The *socio-market scenario* is focused on development with minimal opportunities. Municipal government bodies act "by inertia", i.e. according to the situation, making decisions in order to promptly eliminate problems if there is financial support from regional or federal budgets.

The *evolutionary breakthrough scenario* is associated with the minimal participation of budget funds and city-forming enterprises in the socio-economic development of the city, creating conditions for the development of small and medium-sized businesses.

The *innovative scenario* includes the formation of an organizational and economic territory — a cluster of historically developed buildings, which provides for the implementation of priority investment and innovation projects as part of a strategy to restore the reproduction of the housing sector.

⁴ URL: https://www.consultant.ru/document/cons_doc_LAW_182660/

⁵ URL: <https://www.kp.ru/money/lichnye-finansy/igotnaya-ipoteka-dlya-novykh-regionov/>

⁶ URL: <https://pravdnr.ru/news/minstroj-razrabotal-proekt-pilotnoj-programmy-po-vosstanovleniyu-chastnyh-domostroenij-v-municipalnyh-i-gorodskih-okrugah-respubliki/>

The effectiveness of the decisions taken is assessed according to integral criteria derived from the cost-benefit ratio for all periods of the urban real estate revitalization life cycle. The formation of organizational models for flexible planning of construction and restoration works provides design conditions for three situations:

Resource-intensive situation: a cluster-territory is created in a socio-market type of city, where there are no building resources for its construction. All resources are supplied to the construction site from the main residential and production base of the general contractor organization. In this case, conditions are created to reduce the time of commissioning of the facility, which ($T_b \rightarrow \min$); the level of mobility of the system increases ($Y_m \rightarrow \max$), which leads to additional work; the estimated cost of the facility increases ($K_{bc} \rightarrow \max$) due to the cost of improving mobile systems (pessimistic option).

Motivational situation: a cluster is a territory of an evolutionarily breakthrough type of city being created in a region where it is planned to create industrial and social spheres of appropriate capacity. All the work included in the components of the system life-cycle is performed sequentially. In this case, the minimum level of mobility of the country's system is achieved ($Y_m \rightarrow \min$); the minimum amount of investment is directly in the cluster facilities ($K_{bc} \rightarrow \min$) and additional investments are required in the production and social spheres of the system ($K_{vo} \rightarrow \max$). This leads to an increase in the time required for the commissioning of urban real estate revitalization facilities ($T_b \rightarrow \max$) (a pessimistic option).

Balanced situation: the cluster-territory is being created in an innovative type of city, which provides a rational combination of the use of head-mounted stationary, mobile and regional residential production facilities during the implementation of the investment megaproject (optimistic option).

Based on the results of scenario modeling of the TMFC housing stock development and the choice of organizational models for flexible planning of construction and restoration work, activities are being built to strategically focus all participants in the process of updating cluster territories in the life cycle system of urban real estate revitalization and redevelopment.

The process of housing stock reproduction is influenced by the requirements for buildings that must have sufficient durability, ensure resource conservation, life safety and environmental standards. When making decisions on a specific residential facility, it is necessary to use innovative solutions that reflect the current state of world achievements and scientific developments in the field of urban real estate restoration and reproduction. Therefore, the information and switching component is of crucial importance, providing scientific and technical support for the problem of housing renovation in CES conditions.

Solving the problems of reviving new regions is associated with the creation of scientific and educational foundations, the development of equipment and technologies for the restoration of buildings and structures, strengthening damaged structures and components, reducing construction time and reducing costs. Currently, NRU MGSU is headed by the Construction and Architecture industry consortium, which includes Russia's leading construction universities and industry organizations. The Consortium serves as a platform for cooperation in educational, scientific, and analytical fields. The Consortium's activities will strengthen the human resources potential of the construction industry, ensure digital transformation and solve current problems⁷.

A comprehensive approach to the implementation of technical and economic protection measures and to increase the durability of reproducible objects in urbanized territories is represented by the developments of the Azov State Technical University [25]. The formation of a system of parametric regulation of the conditions of "green" construction based on frame technologies using light steel thin-walled structures (LSTS) creates wide opportunities for the prefabricated construction of multi-apartment⁸ and individual⁹ housing structures. Competitive technical, technological, environmental and organizational aspects should be identified among the main priorities for the restoration of urban real estate using LSTS technologies, which make it possible to improve the criteria of usefulness, safety, durability and cost-effectiveness of the use of materials, energy, space and the ecosystem as a whole.

CONCLUSIONS

A methodology for restoring the reproduction of housing stock is proposed based on a scenario approach to modeling the development of a territorial multifunctional complex and updating cluster territories, taking into account social, economic and environmental standards, an increase in the rate of restoration, and the volume of housing reproduction in the liberated regions. The conditions of problem-oriented management are formulated, scenarios for modeling the cycle of the reproductive system of urban real estate revitalization are defined.

The practical significance of the research results lies in the fact that they can be used to implement the programmatic goals of spatial and resource development of housing stock and the quality of the urban environment based on institutional mechanisms and flexible planning systems in Donbass and Novorossiia. Resource-intensive, motivational and balanced situational models are substantiated, allowing for the coordination of construction and restoration work in the life cycle system of urban real estate revitalization and redevelopment.

As the main tool for implementing innovative solutions, the possibilities of the information and switching component of the activities of the industry consortium "Construction and Architecture" with the participation of leading scientific and industry organizations in the field of restoration and renovation of housing stock in CES conditions are considered. The priorities of technical and economic protection and ensuring the durability of urban real estate related to minimizing the risks of negative impact on the ecosystem of construction of urbanized territories are considered.

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⁸ GOST R 70346–2022. "Green" Standards. Multi-Apartment Residential Buildings "Green". Assessment Methodology and Criteria for Design, Construction, and Operation.

⁹ GOST R 71392–2024. "Green" standards. "Green" single-family houses. Assessment method and criteria for design, construction and maintenance.

⁷ URL: https://mgsu.ru/universityabout/Programma_razvitiya/programma-prioritet-2030-/33/suverenitet/suverenitet/

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Проблема восстановления воспроизводства жилого фонда в сложной чрезвычайной ситуации

Введение. Статья раскрывает основные теоретико-методологические аспекты формирования и развития методов управления строительно-восстановительными работами в условиях сложной чрезвычайной ситуации (далее — СЧС). Рассмотрены современные принципы и практики федеральной госпрограммы поддержки освобожденных регионов, требующие адаптации и синхронизации производственного и инвестиционного планирования для преодоления кризисных явлений в жилищной сфере.

Материалы и методы. Объект исследования представляет систему управления восстановлением воспроизводства городского жилищного фонда и качества городской среды Донбасса и Новороссии. Обозначено, что восстановление жилого фонда в условиях СЧС является сложным, ограниченным по ресурсам, времени и территории процессом, требующим корректировки, улучшения и обновления нормативно-правовых, технических, социальных и экономических положений с целью стимулирования возрождения и устойчивого развития освобожденных регионов. Предложена авторская парадигма научно-технологического сопровождения инвестиционных и производственных процессов, включающая

гибкое планирование и проблемно-ориентированное управление пространственно-ресурсным развитием городской недвижимости.

Результаты. На основе структуризации проблемного пространства повреждений и разрушений жилищного фонда предложен сценарный подход к моделированию территориальных многофункциональных комплексов и обновления кластер-территорий развития. Обоснованы ресурсно-затратная, мотивационная и сбалансированная ситуационные модели, позволяющие выполнять координацию строительно-восстановительных работ в системе жизненного цикла ревитализации и редевелопмента городской недвижимости.

Выводы. Теоретико-методологическое обоснование принципов системы управления строительно-восстановительными работами позволяет перераспределять ресурсы, выявлять скрытые возможности и обеспечивать устойчивость реализации программных целей при восстановлении воспроизводства городской недвижимости в условиях неопределенности и рисков СЧС.

Ключевые слова: воспроизводство жилого фонда, чрезвычайные ситуации, городская среда, научно-техническое сопровождение, проблемно-ориентированное управление, ревитализация, жизненный цикл, редевелопмент

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