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Article

Principles of revitalization of industrial areas in Ukrainian cities

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Abstract: The study of industrial areas damaged by the war in 2022–2024 in more than twenty Ukrainian cities and their adaptation to other functions is extremely relevant in our time. The purpose of the article is to reveal the basic principles of the revitalization of industrial and residential areas of the Ukrainian cities of Volnovakha, Rubizhne, Severodonetsk, Lysychansk, Popasna, Shchastia, Toretsk, Bakhmut, Soledar, Avdiivka, Maryinka, Krasnohirka, Vugledar, Mariupol, Donetsk region, Orikhiv (Zaporizhzhya region), Kharkiv, Kupyansk, Bakaliya, Izyum (Kharkiv region), Kherson, Irpin, Bucha (Kyiv region), which were destroyed or damaged by a full-scale war, ensuring environmental sustainability and economic efficiency, taking into account socio-cultural aspects. The article explores the core principles of industrial site revitalization and provides successful examples of their implementation. The transformation of abandoned areas and the redistribution of their functions are analyzed. The article's methodology is based on general scientific methods, including literature analysis, case comparisons, and synthesis of collected data to develop a professional approach to revitalizing neglected industrial sites. The research incorporates an analysis of international analogs of industrial site revitalization, as well as practical visits and field inspections of abandoned industrial areas in Ukraine, which help identify the primary methods and principles applied in revitalization projects. The study emphasizes the importance of revitalization as a key tool for transforming spaces into functional and aesthetically appealing architectural objects. Based on an analysis of international experience in revitalization, recommendations are developed for effective planning and implementation of revitalization projects for neglected industrial areas in Ukrainian cities. The findings provide a theoretical foundation for understanding the revitalization of abandoned urban spaces, promoting sustainable urban development, improving urban functionality, and offering practical applications.

Keywords: revitalization; industrial areas; function; spaces; principles

1. Introduction

Modern Ukrainian cities are facing challenges arising from the full-scale war in Ukraine, which has destroyed cities and left residential and industrial areas and the natural environment devastated and neglected. The complex process of restoring urban spaces from the damage caused, economic restructuring, and the need for sustainable development requires new approaches to the development of such areas. Revitalization of destroyed industrial areas is a key tool for transforming these spaces into functional and aesthetically attractive areas. Analysis of the principles of revitalization of industrial areas that can be adapted to the modern urban context is extremely relevant.

Industrial areas that have lost their original function as a result of the war pose a serious problem for modern Ukrainian cities. They occupy large areas, are in unsatisfactory technical condition and have a significant negative impact on the environmental situation. In particular, the neglect of such areas contributes to the degradation of the urban environment, the emergence of social and economic

problems. Often, due to the lack of new development sites, there is a need to implement revitalization projects for such medium-sized development areas by demolishing the old housing stock and building high-rise buildings [1]. This leads to the eviction of residents from this old area, so the use of abandoned industrial areas for revitalization is extremely relevant. Such industrial areas have significant potential for sustainable infrastructure development. Their proper revitalization can become a driver of economic growth, improve the quality of life of residents and create new opportunities for cultural, recreational and social development. The problem lies in the lack of a systematic approach to the transformation of such areas. Among the key challenges is the need to take into account multiple aspects: environmental, urban, sociocultural and economic.

2. Analysis of recent sources and publications

The revitalization of industrial areas is a pressing topic addressed in numerous studies and publications. The literature review includes an overview of works emphasizing the importance of this issue. In their academic article, Ivashko et al. examine the problem of revitalizing areas in large Ukrainian cities and analyze foreign experience, particularly from Poland, which can be applied to Ukrainian practice [1]. The authors focus on issues such as the revitalization of former industrial sites, the positive impacts of these measures on addressing social and environmental problems in cities, and an analysis of mass housing developments from the 1960s regarding emerging challenges and living quality indicators. The Pervomaisky residential district in Kyiv serves as a case study in their research. Their goal is to explore the revitalization of urban areas in light of social and environmental challenges, evaluate existing experiences, and provide theoretical recommendations based on field inspections of industrial sites and residential areas [1].

The article by O. A. Sych investigates the challenges faced by Ukrainian cities and their impact on the country's economic security. It identifies the ecological and energy crises, alongside the distorted functional structure of industries, as key issues in contemporary post-industrial cities. The resolution of these problems is hindered by the low efficiency of state development programs, insufficient funding, and a lack of cooperation between local authorities and communities. The study suggests adopting European revitalization practices as part of a comprehensive urban sustainability program [2].

In a collaborative study, Sych et al. outline the fundamental principles of urban space revitalization, discuss methodological approaches to financial support for revitalization, and propose management methods for the revitalization process [3].

Horbaliuk, analyzing revitalization experiences in Polish, English, and French cities, explores the issue from the perspective of urban management and sustainable development, highlighting the role of local self-government bodies [4].

In his dissertation, Rybchynskyi examines the revitalization experiences of European cities, identifies the historical and architectural stages of central area development in Ukrainian cities, reveals their architectural and spatial typology, and proposes model strategies for revitalizing the central areas of Ukraine's historical cities [5].

Tyutyunyk and Kupinets, studying the problem of the post-war revival of the urban space of Ukraine, noted that the sustainable development of Ukraine in the context of solving security problems should become the central idea of the economic transformations of the post-war reconstruction of Ukrainian cities [6].

Vizzarri, studying the preservation and reuse of abandoned industrial buildings, which play an important role in the process of urban revival, proposed a system of design criteria that takes into account the factors involved in the transformation process of the building [7].

Grigoryan, Manvelyan, and Sargsyan, in their study proposed methods for the reconstruction of abandoned industrial zones in Yerevan, focusing on the development of ecological and economic criteria [8]. This approach is consistent with the principles of sustainable economic and urban development, ensuring compliance with current legal norms and standards.

The analysis of the literature on multi-faceted studies of the revitalization of abandoned urban spaces highlights the complexity and problems of urban integration and spatial planning, ecological revival and greening, preservation of socio-cultural heritage and economic recovery with community involvement, which must be 6addressed taking into account the specific characteristics of each urban context.

The purpose of the article is to formulate a concept and reveal the main principles of the revitalization of abandoned post-industrial territories and urban spaces destroyed during the war in Ukraine.

3. Materials and methods

The study used a complex of general scientific and specialized methods, in particular, methods of analysis of literature, regulatory and legal acts in the field of regional policy of Ukraine, selective observation, analogies, historical method, comparison of cases and synthesis of the obtained data for a professional systematic approach to the revitalization of post-industrial destroyed and abandoned territories of Ukrainian cities. Based on the analysis of literary and information sources, the problems that arise in the process of revitalization of urban spaces destroyed and damaged by the war of Ukrainian cities and possible approaches to their solution were identified. The method of observation and on-site inspection of damaged and abandoned objects revealed problematic defects of load-bearing and enclosing structures, which are discussed during the reconstruction, restoration and modernization of destroyed and damaged buildings. Visual inspection of the adjacent territory, buildings and elements of landscaping will make it possible to determine the program for the restoration of the spatial structure and landscaping of cities. The historical method will allow us to determine the value of damaged historical buildings in cities that suffered the most during the war and abandoned post-industrial spaces in cities that were less affected by the war, when adapting them for new purposes, preserving their architectural and historical features. The case comparison method allows us to familiarize ourselves with the problems and seek solutions both individually and in group discussions through complex projects that include social, economic, urban planning, construction, environmental, ecological and environmental protection, educational, scientific, and cultural aspects, which are the result of the

revitalization program and are logically related to the tasks of the program for the revival of war-ravaged urban spaces and abandoned post-industrial territories of Ukrainian cities. The successive stages of the research process constitute the methodological basis for the revitalization of destroyed and abandoned urban spaces.

Based on the analysis of literary and information sources, visual inspection, historical, economic, environmental, and cultural factors, four basic principles of revitalization of abandoned post-industrial territories and urban spaces destroyed by military actions have been developed, taking into account urban, environmental, sociocultural, and economic aspects.

This approach provides practical experience and develops skills in analyzing and making individual decisions in the complex process of restoration, reorganization, and revitalization of the urban environment in compliance with legal norms and standards.

4. Presentation of the main material

Revitalization of industrial areas in Ukraine is an important process of restoring abandoned or outdated post-industrial areas destroyed by the war in 2022–2025, aimed at their integration into the modern urban environment, adaptation to the needs of society, and creation of new functional opportunities. This phenomenon is grounded in a theoretical framework that combines knowledge and principles from urban planning, ecology, economics, sociology, and architecture, making it multifaceted and comprehensive.

The term "revitalization" originates from the Latin re-vitalis, meaning "return to life." In the context of industrial areas, this definition reflects the essence of the process—the return of destroyed and neglected urban areas to active use, but with a new functional and social meaning.

In the 20th century, as industrial activity declined in many countries, vast areas occupied by factories, plants, and other industrial facilities lost their economic value. This created a need for new approaches to their utilization. Revitalization emerged as a response to these challenges, beginning in the 1960s and 1970s in Western Europe and North America. Early examples, such as the transformation of London's abandoned docks into the Docklands business hub (**Figures 1** and **2**) or the revitalization of the Ruhr Coal Basin in Germany, laid the foundation for further development of the concept.

Figure 1. Docklands, London before revitalization.

Figure 2. Docklands, London after revitalization.

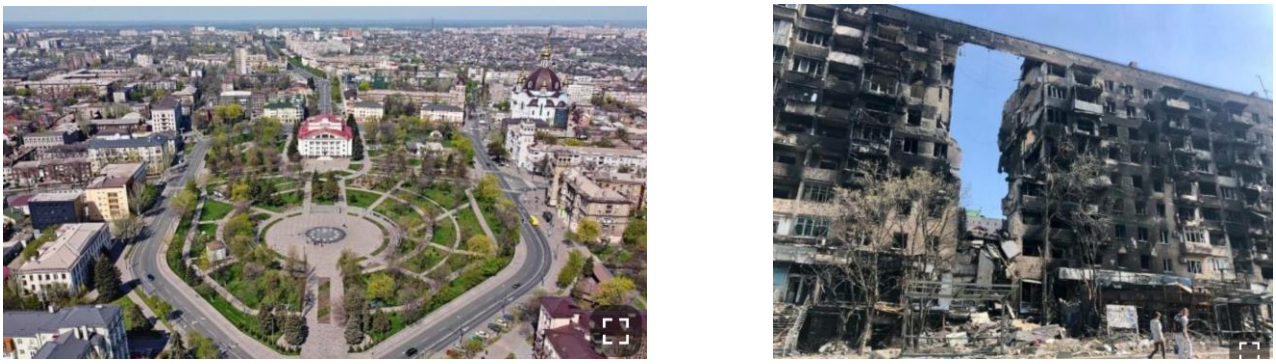
Industrial territories possess a range of specific characteristics that influence their potential for revitalization. These zones typically cover large areas, enabling the creation of expansive multifunctional spaces. Industrial facilities are often distinguished by their structural solidity and massive architectural styles, which can be considered cultural assets. However, the majority of such territories face significant environmental challenges due to long-term soil and water pollution. Their proximity to transport hubs or city centers provides additional development potential but simultaneously necessitates meticulous planning to integrate these zones into the urban infrastructure.

A full-scale war has been going on in Ukraine for two years, during which 20,000 high-rise buildings and 151,000 private houses, 3505 healthcare infrastructure facilities, and over 3790 educational institutions have been damaged. The cities most destroyed are Volnovakha, Rubizhne, Severodonetsk, Lysychansk, Popasna, Shchastia, Toretsk, Bakhmut, Soledar, Avdiivka, Maryinka, Krasnohirka, Vugledar, Mariupol in the Donetsk region, Orikhiv (Zaporizhzhya region), Kupyansk, Bakaliya, Izyum (Kharkiv region), Kherson, Irpin, Bucha (Kyiv region) (**Figure 3**).

Figure 3. Cities that suffered the most destruction during the war on the map of Ukraine (Infographic: O. Shatov).

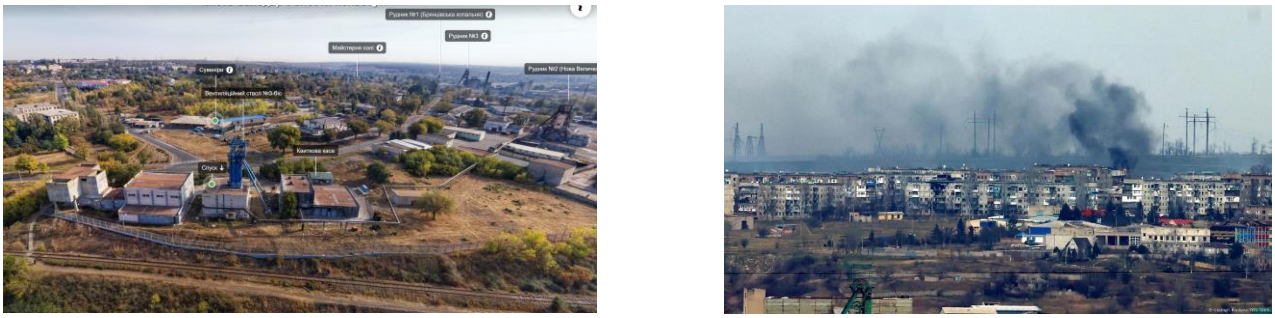
The destruction of the spatial structure of cities during the war also leads to an ecological crisis (**Figures 4–11**). A large amount of waste from destroyed residential

buildings, industrial facilities, household waste in natural landfills and landfills of cities created a critical situation, which leads to a deepening of the ecological crisis and aggravation of the socio-economic situation in Ukrainian society. Therefore, there is a need to reform and develop, taking into account domestic and world experience, the entire legal and economic system that regulates the use of natural resources in general and waste management in particular. In addition to the destroyed industrial facilities of large Ukrainian cities during the full-scale war in Ukraine, almost every industrial city has abandoned industrial areas with depressed elements of urban areas. These elements negatively affect the city's image, vitality, and productivity. They are often the result of historically shaped realities in post-industrial cities. Consequently, addressing this issue involves not only restoring the potential of these areas and improving socio-economic indicators but also implementing comprehensive urban revitalization programs.



(a) **(b)**

Figure 4. Mariupol before and after the war (photo Wikipedia).

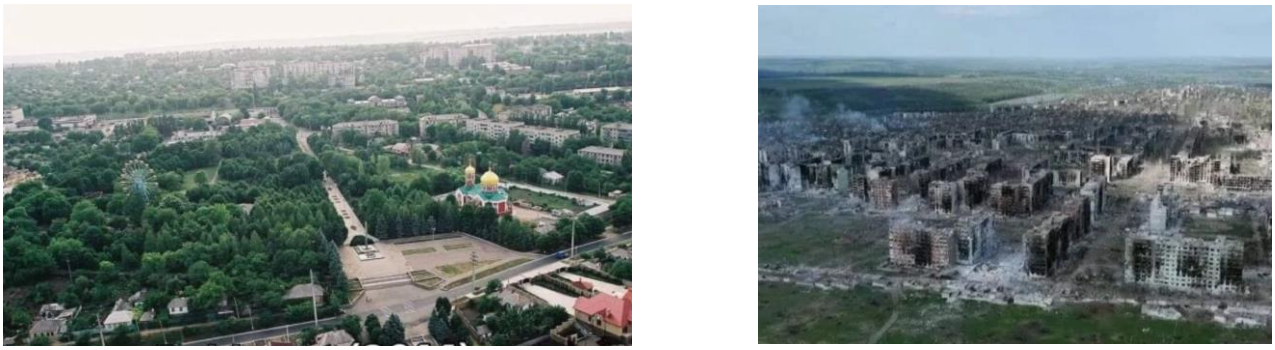


(a) **(b)**

Figure 5. Soledar before and after the war.

(a) **(b)**

Figure 6. Azovstal in Mariupol before and after the war (photo: Associated Press).

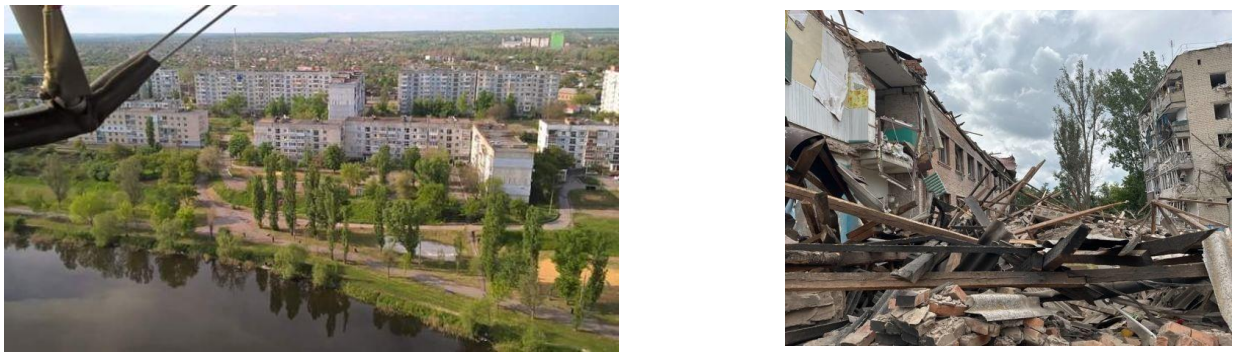


(a) **(b)**

Figure 7. Bakhmut before the war in 2014 and Bakhmut after the war in 2023 (photo from social networks).

Figure 8. Severodonetsk after the war (photo: Serhiy Gaidai).

Figure 9. Lysychansk after the war (photo: Serhiy Gaidai).



(a) **(b)**

Figure 10. Orikhiv (Zaporizhzhya region) before the war and the view after the war (photo from social networks).

(a) **(b)**

Figure 11. Kherson city before and after the war (O. Raikova).

In Ukraine, almost every city has industrial buildings that have lost their original function and are in a state of neglect. Unfortunately, many such structures deteriorate due to local authorities' inaction or the financial inability of their owners to maintain them. Meanwhile, large post-industrial objects have been demolished to create sites for residential and commercial development. While these transformations benefit local communities, they also pose hidden risks, such as increased pressure on communal infrastructure, poorly designed transport networks, and insufficient public space. Hence, a systematic approach to revitalizing post-industrial territories, considering successful European Union practices, is urgently needed. Although the revitalization of abandoned industrial sites in European and American cities began about 30 years ago, Ukraine has only recently started adopting this tool.

Curators of post-industrial zones must protect these spaces from developers while explaining to residents why contemporary art can be a valuable neighbor to impoverished industrial districts. In architecture and urban planning, the restoration and repurposing of abandoned buildings or spaces for new functions help preserve a city's architectural or cultural heritage, diversify residents' lives, and stimulate the emergence of new initiatives and local products.

5. Discussion

The concept of revitalization of urban spaces of Ukraine with innovative infrastructure means giving new life and restoring efficiency and viability to cities regardless of the level of destruction. First of all, it is necessary to focus on the

destruction of historical, social, cultural and intellectual substance, as well as on territorial planning and development of a vision of the spatial future of Ukraine. First of all, this concerns issues: legislative (flexibility of legislation and its compliance with the specifics of the spatial situation); administrative (effectiveness of city and local territory management); social (activity of the community, society); religious-spiritual, mental, as well as their compatibility with the material context and identity of each region of the state [9]. The goal of revitalization is to create balances between economic development, environmental sustainability and social needs. This includes cleaning territories from pollution, creating innovative spaces for living and business, and ensuring community participation in the transformation process.

Contemporary theoretical approaches to revitalization can be classified into several main directions: spatial, social, cultural, economic, and ecological. Spatial revitalization focuses on the development of technical infrastructure, the repair and reconstruction of existing housing stock, the construction of new residential buildings, and the renovation of historical sites, alongside the development of social, cultural, and tourism infrastructure. Social revitalization is centered on the development of human resources, the prevention of unemployment, and providing equal opportunities for scientific activities among children and youth. The foundation of cultural revitalization lies in the reflection of industrial heritage, the preservation of local symbols, and the representation of the history and traditions of a place. Economic revitalization aims to change the structure of the functional area, develop tourism or other industries, launch financial support mechanisms, and create new jobs [10]. Ecological revitalization is focused on solving environmental problems [5]. Ecological revitalization is aimed at restoring the aesthetics of landscapes and the compositional organization of individual spaces, which includes panoramas and the specifics of the visual perception of the landscape; the location of special viewing points; existing silhouettes that open from the main viewing points; and the creation of natural parks and recreation areas, taking into account the features of the landscape environment.

One of the important approaches to revitalization is functional transformation, which involves changing the purpose of industrial territories, such as converting old factories into offices, residential complexes, or cultural centers. Most often, revitalized industrial zones are repurposed for the arts and creative industries, parks, and campuses, as exemplified by the former radio-electronic equipment factory (REMA) in Lviv. Abroad, there are similar examples, such as Medialab Prado in Madrid, Art Inkubator (Fabryka Sztuki) in Łódź, the Jatka 78 theater center in Prague, and the festival hub Melkweg in Amsterdam. There are also larger-scale projects, such as the Brussels Kanal—Centre Pompidou on the site of Citroën garages or the Kunststad arts city replacing the old shipyard in Amsterdam [3].

The most optimal option for revitalizing destroyed or damaged and neglected urban spaces is complex multifunctionality based on national identity and involving territorial communities. Communities are most transparent in planning the best ways of restoration, taking into account their own needs and capabilities. They should be actively involved in the formation of a national strategy for the restoration of infrastructure and the environment. An important aspect is the preservation of socio-cultural heritage, when infrastructure, educational, and cultural facilities are restored, taking into account their architectural and artistic features. When revitalizing historical

industrial buildings, it is necessary to adapt them to new functions but to preserve their authenticity.

A crucial aspect of revitalization is its integration into the urban space. This approach emphasizes the need to consider the overall city structure, ensuring the connection of new territories with transport infrastructure, neighboring districts, and social facilities [3].

Thus, the theoretical foundations of the revitalization of industrial areas reflect its multidimensional nature, encompassing urban integration and spatial planning, environmental, social, economic and cultural aspects. Revitalization is a powerful tool for transforming the urban environment, which not only solves the problem of destroyed and neglected spatial areas but also contributes to the sustainable development of cities, increasing their competitiveness and comfort for life.

The main principles of revitalization of infrastructure facilities and post-industrial territories are formed on the basis of a multifaceted comprehensive approach that takes into account urban, environmental, socio-cultural and economic aspects, which ensure effective and sustainable transformation of destroyed and neglected territories, their integration into the urban environment and adaptation to modern needs of society.

The first and key principle is urban integration. Industrial areas are often located in important parts of the city, but due to their isolation, they often violate the logic of spatial organization. Therefore, revitalization should take into account the connection of such areas with the surrounding environment: Transport infrastructure, residential areas, recreational areas. Spatial reorganization aims not only at the physical development of the territory, but also at creating conditions for its natural inclusion in the overall system of the city [11]. This involves the creation of pedestrian connections, public spaces, and multifunctional buildings that combine residential, office, and cultural functions.

Ecological principles are equally important, especially considering that many industrial territories face significant environmental problems. Polluted soils, water, and air require special solutions for restoring ecological sustainability. This may include cleaning contaminated areas, applying biotechnologies to restore natural resources, and creating green spaces. The ecological component also involves the implementation of energy efficiency principles, such as the use of renewable energy sources, waste recycling technologies, and optimizing resource consumption in new buildings. Ecological restoration of an ecosystem that has been damaged or destroyed during war contributes to the restoration of ecosystem integrity to enhance socio-ecological sustainability and harmony between humans and nature [12]. Green spaces created as part of revitalization not only fulfill ecological functions but also enhance the quality of life for residents by providing spaces for recreation [13]. The advantage of green infrastructure in urban environments is living green walls, green roofs called vertical gardens. Such landscape design offers clear benefits in influencing the temperature of the outdoor environment, depending on the height and density of the building, highlighting the multifaceted benefits of green infrastructure in urban environments [14].

Socio-cultural principles of revitalization focus on addressing the needs of local communities and preserving cultural and historical heritage. Old industrial sites, such

as factories or plants, are often important architectural landmarks that reflect the history of the region. Preserving such sites and adapting them to new functions (for example, converting them into museums, creative hubs, or educational institutions) helps maintain the city's cultural identity. Engaging local communities in the revitalization process ensures greater social support for the projects and creates spaces that meet the real needs of the population. Moreover, these approaches contribute to the development of social cohesion and the integration of different population groups.

Economic principles of revitalization involve ensuring the financial sustainability of projects and creating conditions for economic growth. Revitalized territories can become centers of economic activity, attracting investors, entrepreneurs, and new businesses. For instance, old factories can be converted into office centers, retail spaces, or co-working hubs, fostering the development of small and medium-sized businesses. Efficient use of investment resources and government support allows such projects to be realized with a long-term perspective. Additionally, revitalization creates new jobs both during the design and construction phases and after the transformations are complete.

It is also important to emphasize the interdisciplinary nature of revitalization, which requires collaboration among architects, urban planners, ecologists, sociologists, and economists. This comprehensive approach allows for avoiding one-sided decisions that could negatively impact the long-term results of a project [15].

All of these principles form the basis for creating sustainable, multifunctional, and attractive urban spaces. The revitalization of industrial areas not only solves the problem of destruction and neglect but also contributes to the improvement of the urban environment, increases its ecological and social value, and stimulates economic development. This is a complex but necessary process for modern cities that strive for sustainable and harmonious development.

6. Conclusions

The revitalization of industrial areas is a key direction in the development of modern cities, addressing a range of important social, economic, and environmental issues. This process is not only aimed at physically restoring neglected zones but also at integrating them into the urban fabric while considering the needs of the community and current trends in sustainable development.

As a result of the analysis of urban spaces destroyed during full-scale war and neglected, it was found that successful revitalization is based on four main principles. The ecological approach promotes the cleanup of polluted sites, reduces the negative environmental impact, and introduces energy-efficient technologies. The socio-cultural component preserves historical heritage and creates spaces that meet the needs of local communities. The economic sustainability of projects is ensured by attracting investments, developing businesses, and creating new jobs.

There are numerous successful examples of revitalization in global practice that demonstrate the effectiveness of a comprehensive approach. However, in Ukraine, such projects are still in the development phase and face many challenges, including insufficient funding, bureaucratic obstacles, and environmental difficulties.

For the successful implementation of revitalization projects in Ukraine, it is important to take into account international experience, adapting it to local conditions, and to ensure an interdisciplinary approach that unites specialists from different fields: architects, designers, builders, ecologists, and economists. Engaging communities in planning and implementing projects is a key factor in increasing their social significance and support.

Thus, the revitalization of industrial areas is a powerful tool for transforming cities, creating sustainable, multifunctional spaces, promoting community development, and improving the quality of the urban environment.

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