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STUDYING THE PROCESSES OF REVITALIZATION OF INDUSTRIAL AREAS ON THE EXAMPLE OF KYIV CITY

Background. *Kyiv, as the capital of Ukraine, faces the issue of neglected industrial areas that negatively impact the urban landscape, economy, and ecology. Revitalization processes can become a key element for the sustainable development of the city in the future. The article aims to explore the current state of industrial areas, their potential for transformation, and the main directions of revitalization.*

Methods. *The research is based on a comprehensive approach, including the analysis of statistical data, the study of successful cases, and field research. A comprehensive approach is applied for conducting revitalization research of industrial areas, including the following methods: document analysis, field research, cartographic analysis, sociological surveys, comparative analysis, economic analysis, and environmental assessment.*

Results. *The economic, social, and environmental aspects of the revitalization process are analyzed to identify prospects for different areas. Based on the data, strategies for the development of various city districts, taking into account their specifics, are proposed. By analyzing Ukrainian and foreign sources, the social and economic benefits associated with revitalization, including the creation of new jobs, business development, crime reduction, and quality of life improvement, are examined. The main problematic points remain financial costs, corruption, and lack of interest from authorities.*

Conclusions. *The conclusions present strategies for the optimal use of urban areas through revitalization from environmental and social perspectives. It is important that revitalization allows for the preservation of historical heritage, ensuring the stability of Kyiv's development. The research results can serve as a basis for further revitalization projects of urban areas in Ukraine, contributing to the improvement of the urban environment and the integration of modern practices into urban planning.*

Keywords: *revitalization, renovation, industrial areas, sustainable development, Kyiv, urban planning, brownfields, adaptive transformation.*

Background

Modern cities, both large and small, face a range of various issues driven by globalization. These challenges relate to phenomena such as unemployment, urban sprawl, social alienation, criminalization, economic instability, and more. Ukrainian cities, particularly Kyiv, also experience several problematic aspects. One of Kyiv's distinct features is its urban sprawl due to the construction of residential areas, industrial complexes, and commercial spaces around the city's borders. Although the speed and scale of construction in the metropolitan region are expanding, the capital has neglected areas within the city.

One of the issues is the significant proportion of industrial zones that are not fully utilized or remain entirely idle. Kyiv has a substantial share of non-functioning industrial buildings, former factories, and partially ruined architectural structures inherited from the Soviet Union. Former industrial zones with residential districts for workers were previously located on the outskirts of the city. With the expansion of the city and the shift from a planned to a market economy, these industrial areas ended up inside the city and ceased to serve their original functions. Abandoned industrial sites pose a risk by potentially increasing criminal activity, thus deteriorating both the appearance of the urban environment and safety in the area.

To prevent these problems, it is necessary to use the available land efficiently. This may include the modernization and launch of safe and environmentally friendly enterprises or the reorganization of spaces for other functions. In developed countries, the repurposing of such areas through the revitalization of industrial zones has long been known and popular. In such projects, non-operational factories and plants can be repurposed for residential development, commercial buildings, or public spaces. In the 1950s, the United States, Europe, and Asia began implementing revitalization projects as a way to restructure the economy to meet modern needs in a globalized world (Sych, 2020).

The relevance of studying the revitalization of Kyiv's industrial zones is driven by the need for efficient use of urban space, improving the environmental situation, and creating new economic opportunities. In the context of modern urban trends, the transformation of abandoned industrial areas becomes a key tool for sustainable urban development (Horbliuk, Brovko, & Kudyn, 2022). Kyiv, as the capital of Ukraine and the largest industrial center in the country, has significant potential for implementing revitalization projects, which can significantly impact the quality of life for residents and the city's economic development.

The purpose of the study is to theoretically and methodologically analyze the potential of revitalization processes and identify the main directions and prospects for the revitalization of industrial zones in Kyiv, taking into account European experience and local characteristics.

The tasks of this research include analyzing the current state of Kyiv's industrial zones and assessing their potential for revitalization. Additionally, it involves developing recommendations for a revitalization strategy for Kyiv's industrial zones, considering economic, social, and environmental aspects.

Analysis of Recent Studies and Publications. Analyzing recent studies and publications reveals an increased interest in the issues of revitalizing industrial zones both in Ukraine and abroad. Some authors, in particular, explore the repurposing of industrial buildings for new functions, such as coworking spaces and innovative infrastructure (Dmytrenko, Ivashko, & Ivashko, 2021). Their research demonstrates the potential of adaptive reuse of

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industrial facilities in the context of modern urban economic development (Horbliuk, Brovko, & Kudyn, 2021). It is also worth noting studies that explore the transformation of industrial areas in the context of urban development in Ukraine (Dronova, & Maruniak, 2019) and examine revitalization issues as part of a broader study of urban processes in Ukraine (Mezentsev, Oliynyk, & Mezentseva, 2017).

In the European context, research has identified key success factors for revitalization projects, including the implementation of green building practices and consideration of the income levels of nearby residents (Green, 2018). These findings can be useful for developing revitalization strategies in Kyiv. The importance of a participatory approach and the involvement of local communities in the revitalization process is emphasized. The author argues that public participation is a critical factor in ensuring the sustainability and social acceptance of revitalization projects (Gudz, 2017). Additionally, significant attention is paid to the concept of sustainable urban development as a theoretical basis for the revitalization of industrial zones. Authors highlight the need for a harmonious combination of economic, social, and environmental aspects when transforming urban spaces (Biloshytska et al., 2023).

The research also explores mechanisms of public-private partnerships and attracting investments through the creation of special development funds in European countries. Their experience can be adapted to Kyiv's conditions to enhance the efficiency of revitalization processes (Sykes, & Schulze Bäing, 2017).

Theoretical Framework of the Study. The theoretical basis of the study is the concept of revitalization, which is viewed as a comprehensive process of restoring and renewing urban areas. The term was first used in an article by Anthony F. C. Wallace in 1956 under the title "Revitalization Movements," to describe a specific feature of cultural change. A revitalization movement is a conscious effort by members of society aimed at innovating a cultural system (Wallace, 1956). Since then, the term has become widely used across various disciplines. According to the Cambridge Dictionary, revitalization is explained as the process of development, renewal, and acquiring new opportunities for success.

In the educational guide Urban Revitalization – European Union Experience for Ukraine, the term is defined as a multifaceted process aimed at restoring urban areas that have suffered structural degradation, leading to a crisis state that hinders the economic and social development of the area and complicates the process of sustainable development. Urban revitalization includes preserving the original appearance of buildings and reconstructing premises, changing their functional use to non-industrial purposes, and creating public spaces, office spaces, shopping centers, or housing (Sych et al., 2023).

An important aspect of the theoretical foundation of the research is the concept of brownfields. The term "brownfield" refers to land that is not fully utilized, neglected, and contaminated. It results from past industrial, agricultural, residential, military, or other activities. A brownfield cannot be properly and effectively used without a regeneration process (Podhrushnyi et al., 2023).

Various terms are used to describe the processes of urban renewal, which are often interchangeable but have their own characteristics: Revalorization, as defined by V. V. Vechirny, is a set of measures aimed at restoring and improving the aesthetic and artistic value of a building (Vechirny, 2022). This approach is especially relevant for improving damaged components of historic city center ensembles. In the monograph "Renovation of Industrial Buildings and Their Adaptation to the Modern Urban Environment," renovation is defined as a set of works to preserve heritage and renew space through the reconstruction and adaptation of buildings to modern needs, which may include restoration (Hayko et al., 2021). According to the Ministry of Communities and Territories Development, reconstruction is a set of works aimed at improving technical and economic indicators, working conditions, and the quality of the final product or service through the reconstruction of civil or industrial facilities (Minrehionbud ta zhytlokomunhosp, 2011). The main component of reconstruction may be a major overhaul of the facility. Modernization is the restoration of an object due to its obsolescence by improving its technical performance in accordance with modern conditions (Shishkin, & Zavalnogo, 2021).

Methods

The research methodology is based on a comprehensive approach that includes the analysis of statistical data, the study of successful revitalization cases, and field research in the former industrial zones of Kyiv.

A comprehensive approach is used to study the revitalization of industrial areas, including the following methods: 1. Document analysis: study of urban planning documentation, statistical data and historical materials to determine the state of industrial areas and their potential for revitalization. 2. Field survey: visual inspection of industrial sites and adjacent areas to assess their physical condition, architectural value, and potential for adaptive reuse. 3. Cartographic analysis: creation of mapping schemes of industrial areas, their location in relation to other urban objects and identification of spatial patterns. 4. Sociological surveys: conducting interviews with local residents to determine the needs of the community and the vision of the future development of industrial areas. 5. Comparative analysis: studying successful examples of industrial revitalization to identify best practices and opportunities for their adaptation. 6. Economic analysis: assessment of the economic feasibility of different revitalization scenarios, including cost-benefit analysis. 7. Environmental assessment: study of the level of pollution of industrial areas and development of measures for their environmental rehabilitation.

Data for the study include: 1. Statistical data on the number and area of industrial areas in the city, their use and condition. 2. Historical documents and photographs reflecting the development of industrial areas. 3. Urban planning documentation, including the city's master plan and zoning plans. 4. Results of surveys and interviews with stakeholders. 5. Environmental monitoring data for industrial areas. 6. Economic indicators related to industrial zones and their revitalization potential. 7. Cartographic materials and aerial photographs of industrial areas. This methodology allows for a comprehensive analysis of industrial areas and the development of effective strategies for their revitalization, taking into account the principles outlined in the source text.

Results

Industrial zones, which we see daily in various urban areas, began to form primarily in the early and mid-20th century. Initially, industrial areas were developed on the peripheries of urban spaces. However, with urbanization and the expansion of cities, these industrial areas found themselves in close proximity to city centers. Today, a

significant portion of these zones has lost their original purpose and is mostly used as storage spaces or locations for small businesses (Bodnar, & Yasinskyi, 2023).

According to the main provisions of the Kyiv General Plan for 2025, developed by the Municipal Organization "Institute of the Kyiv General Plan," as of 2011, the total area of industrial and industrial-warehouse territories in the city amounted to 8,342.2 hectares. However, in the revised document of 2015, this figure was reduced to 6,912.3 hectares (Master plan of Kyiv, 2015).

The industrial and municipal-warehouse sector of Kyiv comprises 10,000 enterprises located in 20 industrial districts, several industrial zones, and isolated sites outside these districts. The total land area allocated for industrial and municipal-warehouse enterprises amounts to 6,912.3 hectares. Most industrial zones are located on the right bank of the Dnipro River. The largest ones include the "Podilsko-Kurenivsky" industrial district (891 ha), "Nyvky" (560 ha), "Telichka" (424 ha), "Vidradny" (400 ha), and the industrial zones of "Pyrohovo" (171 ha) and "Korchuvate" (80 ha). On the left bank, industrial districts include "Darnytsky" (460 ha), "Dniprovska" (380 ha), "Troieshchyna" (316 ha), and the "Bortnychi" industrial zone (324 ha). Currently, almost 47 % of industrial areas are used inefficiently. Many enterprises require restructuring, repurposing, ecological and sanitary improvement, more efficient land use, and enhancements in the architectural and aesthetic quality of the developments (Podhrushnyi et al., 2023).

Revitalization in Kyiv is gaining momentum due to several reasons, including: limited land availability for new developments in the city's central areas; increasing rental costs and land-use fees, which incentivize more efficient utilization; rising demand for commercial real estate; limited financial resources among developers; advances in reconstruction technologies; satisfactory structural conditions of many facilities; the presence of industrial enterprises in the city center; the design features of industrial buildings that are well-suited for commercial adaptation; availability of engineering capacities, as industrial sites traditionally possess high energy, heat, gas, and water resources; the entry of large private investors into the commercial real estate market; and the development of cultural projects (Hnatiuk, & Melnyk, 2019).

All these factors served as a catalyst for the first revitalization initiatives of industrial sites in Kyiv. The first wave of revitalization began in the 1990s, when enterprises started renting out premises for warehouses or offices. Some of these spaces were converted into auto services, stores, or small offices. Gradually, more active attempts were made to reorganize areas for commercialization. Today, Kyiv has many successful examples of repurposing various facilities into residential and commercial real estate. The first factory to undergo revitalization was "Artem" in 1997. However, the main wave of revitalization occurred in the 2000s and 2010s. Many potential projects were paused due to the 2008 financial crisis, which, nevertheless, prompted investors to consider revitalization as an alternative to the expensive demolition of old buildings for the construction of new complexes. Initially, revitalization involved repurposing spaces for office and commercial use, but there is now a trend toward the comprehensive redevelopment of areas into large multifunctional complexes. Among the most famous examples are "Art-Zavod Platforma" and "Mystetskyi Arsenal". Overall, Kyiv has over 45 revitalized sites, including business centers, shopping and entertainment complexes, cultural and art spaces, hotels, residential complexes, and apartments. Brownfields are most often transformed into multifunctional centers or business centers, as office spaces are a faster and simpler way to turn an area into a liquid asset. Shopping and entertainment complexes appeared later. Though more expensive to build, they yield a greater economic effect for the development of adjacent areas. The "Comfort Town" project is a vivid example of transforming an industrial zone into a residential neighborhood. The residential complex is located on the former site of the "Vulcan" factory, where rubber shoe parts were once produced; now, it is a colorful residential complex. The complex is enclosed and built based on the "city within a city" concept. Despite differing opinions, this residential complex is an excellent example of brownfield revitalization in Kyiv (Fig.1).

Business centers are also frequently located on former industrial sites. For instance, the "Artem" business center was opened on the site of the former "Artem" factory canteen, and an office center was created from an old toy factory. Other notable projects include the "Kubik" office center, Horizon Park, the "Forum" business town, the "Renaissance" office center, and the "Lastivka" trade and office center in Podil, created on the site of a clothing factory. In 2001, the "Tomak" factory building was converted into the "Valmi" office center, now housing the "AVT Bavaria" service center.Industrial buildings in Kyiv have also been adapted into shopping centers. The largest include the "Cosmopolitan" shopping mall on the former site of the "Bolshevik" factory, the "Karavan" shopping center in Obolon, the "Horodok" and "MegaMarket" near the "Petrivka" metro station, as well as the "Promenad" shopping center in Tatarka and the "Rytm" shopping center in Borshchahivka. Among cultural and artistic spaces, the "Art Zavod Platforma" stands out. It is located on the former grounds of a silk factory built in 1947. In the early 2000s, part of its workshops was repurposed into the "Darynok" shopping complex, and in 2014, the "Art Zavod Platforma" was established, hosting festivals, workshops, exhibitions, and large concerts. Another example is "UNIT.City," Ukraine's first innovation park, created on the site of the former Kyiv Motorcycle Plant. The park positions itself as a space for business, research centers, and residential development with full infrastructure, including the programming school UNIT.Factory. These large, entirely transformed public spaces are often associated with revitalization in the capital. However, not all industrial areas undergo complete revitalization; sometimes only a specific section is redeveloped, leaving other parts of the area abandoned until they deteriorate completely.

Kyiv has many industrial areas that have started to decline, prompting provisions in the 2015 Kyiv General Plan for the prospective reimagining of industrial zones. A proposal was made to repurpose 1,942 hectares of industrial sites for multifunctional, public, and residential developments, as well as for greening and engineering-transport infrastructure. Potential areas for reform include districts with dysfunctional areas that are suitable for transformation, such as "Podilsko-Kurenivsky", "Mykilska Borshchahivka", "Nyvky", "Telichka", "Pyrohovo", "Korchuvate", "Dniprovska", "Darnytsky", "Voskresensky", "Troieshchyna", and others. It is also essential to reconstruct and modernize enterprises in the city's central areas, residential, and recreational zones, which negatively impact public health and the environment due to pollution and emissions. These include the Kyiv Meat Processing Plant, the "Kuznia na Rybalskomu" factory, "Budshlyakhmash", "Gazprylad", and other enterprises near Yaroslavska, Skovorody, Hlybochytska, Kyrylivska streets, and along the Lybid River. In the absence

of measures to minimize harmful emissions, the functional use of these areas could be changed to public development, greening, and parking. Additionally, for environmental restoration and greening of sanitary protection zones on 49.2 hectares, there is a planned restructuring to transform parts of industrial zones along the Dnipro River in the "Telichka" and "Podilsko-Kurenivsky" areas (Hnatiuk, & Melnyk, 2019).

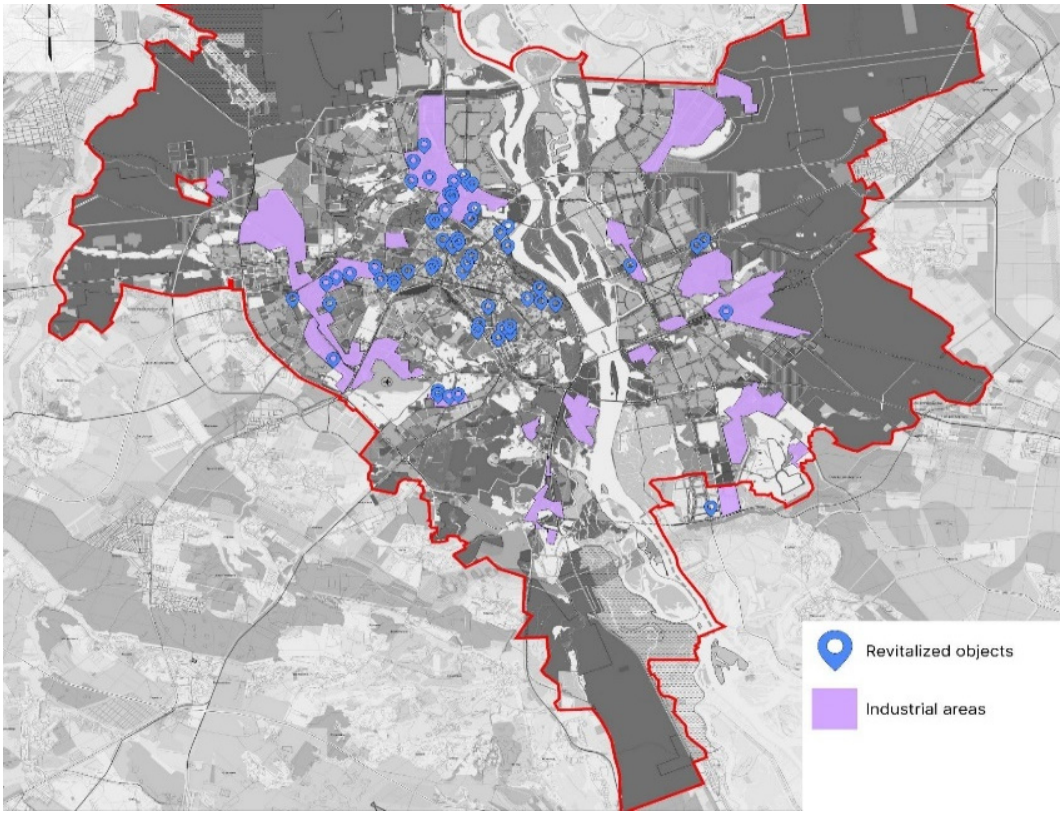

Fig. 1. Map of Revitalized Sites in Kyiv

The enterprises located in the city center currently do not meet urban planning requirements in terms of both functionality and construction quality. Enterprises located in the coastal zone of the Dnipro River within the "Telichka" industrial district and the Podilsko-Kurenivska industrial zone occupy the most valuable, yet investment-unattractive areas. In Kyiv, there is high demand for residential housing, office spaces, and commercial and entertainment complexes. This has defined the main trend of the functional transformation of industrial areas in Kyiv, particularly in its central part. The central industrial district demonstrates a high level of deindustrialization: employment in industrial enterprises decreased by 81.7 % from 1995 to 2018. Other industrial districts with significant deindustrialization include Pozniaky (–89.0%), Korchuvate (–77.8%), Bortnychi (–77.5 %), Vasylkivskyi (–77.0 %), Darnytskyi (–72.4 %), Dniprovs'kyi (–65.0 %), Vidradnyi (–63.4 %), Zaliznychnyi (–59.6 %), and the Podilsko-Kurenivska industrial zone (–58.5 %), as well as five territorial groups of enterprises. Industrial districts with moderate deindustrialization include Bereznyaky (–49.1 %), the Kyiv-Pasazhyrskyi railway station area (–43.9 %), Dehtiarivska Street (–35.4 %), and Voskresenskyi (–33.4 %). The lowest level of deindustrialization is observed in the "Nivky" industrial zone (–22.9%) and the industrial districts of Mykilska Borshchahivka (–14.3 %), near the Post-Volynskyi station (–5.4%), and Telichka (–5.3%) (Master Plan of Kyiv, 2015).

Kyiv has numerous industrial and warehouse areas that are partially or completely unused and may be promising for revitalization. The popularity of such an approach is due to a number of factors, including the presence of old industrial facilities, land costs, wage levels, transport accessibility, demand for commercial real estate, and so on. Social indicators are also important for assessing the revitalization potential: the population size, the number of people employed in the area, and the average wage. In recent years, many areas of Kyiv have experienced population growth due to natural increase and migration. For example, since 2007, there has been significant growth in the Solomianskyi district, while the Shevchenkivskyi district has seen a population decline.

As of 2022, the population varies from 160 thousand in Pecherskyi to 384 thousand in Solomianskyi, which indicates a need for the development of social infrastructure in Solomianskyi. Although most residents of Solomianskyi live there, they predominantly work in Shevchenkivskyi and Pecherskyi, which are business centers. Over the past five years, the employment rate has changed: the number of employees in Shevchenkivskyi district has grown slowly, while in Pecherskyi there has been a significant increase. In 2021, about 262 thousand people were employed in Shevchenkivskyi, exceeding the figure for Pecherskyi by 60 thousand people. Districts with average employment rates include Solomianskyi and Holosiivskyi, while Desnianskyi district has the lowest employment rate and a decrease in the number of workers.

The number of enterprises also shows significant differences between districts. In 2021, the highest figures

were recorded in Shevchenkivskyi (19 thousand enterprises) and Pecherskyi (17 thousand) districts. Holosiivskyi and Solomianskyi have average figures, while the fewest enterprises are located in Desnianskyi district – only 3 thousand. The data indicates that the greatest potential for revitalization lies in the residential districts, particularly Desnianskyi, Dniprovs'kyi, Sviatoshynskyi, and Darnytskyi, where there is a large housing stock. However, a lack of jobs forces residents to look for work in other districts, causing traffic congestion, especially on bridges across the Dnipro. Revitalizing non-functional industrial areas for offices or coworking spaces can enhance the investment appeal of these districts, create new jobs, and develop infrastructure. As employment grows in residential districts, their attractiveness for affluent residents will increase, contributing to overall economic growth. Wages also influence the feasibility of revitalization projects. Over the last five years, the average wage of employees has risen by approximately 8 thousand hryvnias across Kyiv. The highest wage levels are recorded in Pecherskyi, Podilskyi, and Holosiivskyi districts, where salaries are 25, 23, and 22 thousand hryvnias, respectively. In Desnianskyi, Dniprovs'kyi, and Darnytskyi districts, this figure is significantly lower – 14, 15, and 16 thousand hryvnias. The greatest wage growth is observed in Pecherskyi, Podilskyi, and Shevchenkivskyi districts, indicating a high level of commercialization in these areas. The development of new businesses in central districts may deepen the gap in the quality of life between the center and the periphery. Therefore, it is more advisable to focus efforts on developing residential districts by creating multifunctional complexes and ensuring opportunities for local employment.

Economic indicators significantly impact the character and process of urban revitalization. Key statistical data, such as the dynamics of prices for residential and non-residential real estate in various districts and the volume of new construction, are crucial for the strategic development of the city. Revitalization as a strategy involves attracting investment for the development of neglected industrial areas, often including business and cultural-entertainment facilities. This is especially relevant for central urban areas, where high land prices and investor interest promote development.

The revitalization of industrial areas or brownfields can involve various functional purposes, such as residential, commercial, cultural, or innovative use. The selection of optimal sites depends on the specifics of each district. The initial analysis stage includes evaluating the volume of new residential construction as an indicator of district development. Statistical data show significant variability, including active development in the Darnytskyi, Holosiivskyi, and Shevchenkivskyi districts in 2019, as well as high indicators in the Podilskyi district in 2022. In the long term, the Holosiivskyi, Darnytskyi, and Pecherskyi districts demonstrate stable growth, while the Desnianskyi, Sviatoshynskyi, and Obolonskyi districts have the lowest indicators, suggesting their lesser investment attractiveness.

Land price policy is a defining factor for investors and depends on location, transport accessibility, and district prestige. Over the last decade, average prices in both the primary and secondary markets have doubled, from $750 to $1500 per square meter. Economic instability, inflation, and conflict events have affected price fluctuations: for example, in 2014, the average price on the primary market was $1450 per square meter, and in April 2024, it decreased to $1240. Price comparisons across districts show the highest values in the Pecherskyi, Shevchenkivskyi, and Podilskyi districts, where prices reach $87,000, $60,000, and $58,000 respectively, indicating the prestige and demand for housing in the center. However, new residential complexes often lack social infrastructure, leading to issues with school places, parking, and green areas. The most affordable housing prices are in the Desnianskyi and Darnytskyi districts, due to their distance from the center and less developed transport infrastructure.

Based on these data, it can be concluded that revitalization processes should be implemented on the left bank and peripheral areas to stimulate their development and increase the number of jobs. It is best to develop innovation centers, multifunctional office complexes, and IT hubs. However, active development of peripheral areas could lead to gentrification processes, so such projects should align with the city's development plans. In contrast to the periphery, in central districts, it is more effective to revitalize areas into social infrastructure and green zones to reduce pressure and improve the quality of life in densely built areas.

When analyzing revitalization from a commercial use perspective, one of the key aspects is the attention to the dynamics of commercial real estate rental, which is determined by the diversity of offers and price differentiation at the regional level. Over the last six years, there has been significant price growth in all city districts, especially in the Pecherskyi and Holosiivskyi areas. The price per square meter of commercial real estate in 2024 ranges from $910 in the Desnianskyi district to $2884 in the Pecherskyi district. Consistently the highest prices are in the Pecherskyi, Shevchenkivskyi, Podilskyi, and Holosiivskyi districts. Despite its less business-oriented status, Holosiivskyi district also shows a growth trend, providing convenient locations for businesses. The highest number of office rental listings is also observed in the Shevchenkivskyi and Pecherskyi districts. These areas have long been prestigious business centers, which is reflected in the high office rental prices. However, there are also available options for small businesses.

The fewest rental listings are found in the Desnianskyi, Sviatoshynskyi, and Dniprovska districts, indicating the need for business development projects in these areas. Revitalizing industrial zones into office establishments throughout the city could act as a catalyst for increasing business activity, creating competition for existing commercial establishments, increasing the number of jobs, and transforming districts into multifunctional areas.

The environmental aspect of industrial zone revitalization plays a key role in improving the state of the environment and ensuring the health of local residents. Often, industrial sites become sources of pollution by toxic substances due to previous industrial activities or long-term neglect of building structures. Therefore, the first step in the restoration of brownfields should be the cleaning of polluted areas. After full removal of contaminated soil, the site can be reconstructed with the organization of green zones or even small parks. This would create additional public spaces that relieve the central parts of the city, improve air quality, aid in the rehabilitation of nature, and create a healthier environment in the area. Moreover, it is important to consider energy efficiency during building revitalization. The use of energy-efficient technologies can help reduce energy consumption and greenhouse gas emissions. Buildings should harmoniously integrate all aspects of the natural environment with human activity through the rational use of resources and minimizing the negative impact on the environment.

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In Kyiv, the level of greenery varies depending on the district and proximity to the center, as shown on the greenery map. For instance, the central districts of Shevchenkivskyi and Pecherskyi, as well as Obolon, are characterized by high levels of development and insufficient greenery for comfortable living. Therefore, a good revitalization option would be to repurpose the area into park zones or small squares to increase the number of public spaces with appropriate greenery, which will improve ecological indicators in the area and expand public recreational zones.

The highest level of adaptive transformation is observed in the Central Industrial District, where in 2018, the share of residential development was 31 %, and commercial development was 10.6%; the Railway District had 24.2 % and 7.7 % respectively; Degtyarivska Street (20.6 % and 7.2 %); and the Podilsko-Kurenivska Zone (7.7 % and 14.1 %). Some territorial enterprise groups have been completely replaced by residential development. A significant level of post-industrial transformation characterizes several areas in Kyiv, particularly the Podilsko-Kurenivska industrial zone and parts of Degtyarivska Street, where the "Unit City" innovation park is located, bringing together IT companies, creative companies, and educational platforms. In the Railway Industrial District, there are large business centers, engineering companies, real estate agencies, the central office of a bank, and a consulting firm. The Central District hosts enterprises from the tertiary sector, including IT companies, engineering firms, advertising agencies, and consulting firms. In the Vidradnyi industrial district, there are large business centers such as "Premium", "Incom", "Silver Center", and "Inox". The Voskresensky industrial district hosts IT companies, central bank offices, advertising agencies, insurance, auditing, and engineering firms. On Vasylkivska Street, there are large business centers "Stend", "Gloria", and a consulting firm. The Nivky industrial zone hosts the "Nivky City" business park, as well as insurance and engineering companies. In the Mikhailivska Borshchahivka industrial district, there is the "Rent City" business center. The Dnipro Industrial District hosts the "FIM Center" business center and the "Platform" art factory, as well as high-tech enterprises. In the Darnytsky industrial district, the "ArmTek" business center operates, along with auditing and engineering companies. The Bortnychi area hosts an IT company and two engineering companies. Other industrial zones in Kyiv have not yet shown significant signs of transformation. Therefore, further activation of this process requires a systematic approach aimed at creating a favorable environment for the development of creative and innovative industrial functions on these territories, as well as their optimal combination with recreational, health, and educational-cultural functions.

Kyiv is characterized by a significant concentration of industrial objects, zones, and districts. Certain abandoned territories have already undergone revitalization processes, but many objects still have potential for further restoration. For instance, the "Kyiv Automation Plant named after H. Petrovsky" is one of the partially restored objects, which still holds development potential. This plant, located in the Shevchenkivskyi district, previously functioned as a significant scientific-production association specializing in the production of high-precision gyroscopic instruments.

Founded in 1903, the plant started as a cast-iron enterprise, with construction initiated in 1898. By 1905, it became part of the "Auto" joint-stock company, specializing in equipment for the sugar industry, boilers, bearings, and cast iron and bronze castings. The innovative stage of the enterprise began in 1911 with the creation of an experimental workshop by the Kyiv scientific society "Physico-Chemist". In 1915, this workshop became part of the Military-Industrial Committee, starting the production and repair of communication devices and optical equipment. In 1926, several Kyiv instrument-making enterprises, including the "Physico-Chemist" workshop, were consolidated into the "Tochprylad" enterprise, which was renamed in 1928 after H. Petrovsky. A significant achievement of the enterprise was the development in 1934 of the first domestic gyroscopic instruments for managing maritime objects, commissioned by the naval fleet. During World War II, the enterprise was evacuated to Gorky and operated under the name "Plant No. 215". In 1946, a Special Design Bureau was founded at the plant. After the collapse of the USSR, the enterprise, like many other industrial objects, underwent gradual decline.

Today, on the site of the Kyiv Automation Plant, there are numerous non-core establishments, such as the Northern Appeal Economic Court, the "Povitroflotsky" residential complex with a commercial first floor, "Kubik Center", the business center "Vector", the "R&D Center DataArt" in Kyiv, the medical center "Miy Likar", the "MediLand" MC, "Palo Alto Business Center", the "1GO" sports club, the International Business Institute, the "Starokyivsky" residential complex, the "Lyasy" anti-cafe, International House Kyiv, the customs broker "Vlasni Meregi Ltd", the "Inside Production" photo agency, and many others (Fig. 2).

Despite the active revitalization, two problematic areas remain. These include three abandoned workshops with broken windows, which negatively affect the aesthetics of the area and pose security risks. The first problematic zone includes a building in Stalinist Empire style, surrounded by a residential complex and the Northern Appeal Court, making the abandoned workshops visible from the windows. This workshop area borders the "Povitroflotsky" residential complex and begins directly behind the children's playground, creating an unpleasant neighborhood (Fig. 3).

The second problematic area is located at the corner of Rostyslavska and Sholudenko streets, and attracts attention with its dilapidated condition, including broken windows. These buildings have the potential for high-quality renovation, taking into account all the necessary standards and the needs of the residents.

To develop effective revitalization strategies, a thorough analysis of the existing objects is necessary to identify the shortcomings and needs of the neighborhood. For this purpose, a map scheme was created, showing key components: residential areas, social, governmental, and commercial infrastructure objects (Fig. 4). Analyzing the prestige of the district, the development was divided into new and old. A large number of new comfort- and business-class residential complexes indicates the high attractiveness of the district and its popularity among Kyiv residents. The variety of functions in the area confirms its development and the availability of necessary services. These indicators are important for revitalization, and the absence of certain objects should be compensated by their planning.

Fig. 2. Partial revitalization of the study area of the Kyiv Automation Plant named after G. Petrovsky: a) Kubik Business Center; b) Northern Commercial Court of Appeal and Povitroflotskyi Residential Complex; c) Mediland clinic; d) Starokyivskyi residential complex

Fig. 3. Location of problem areas of the automation plant

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Fig. 4. Infrastructure of the study area

The largest area on the map is occupied by social infrastructure objects, including medical facilities such as the National Children's Specialized Hospital "Okhmatdyt", medical centers "Miy Likar" and the Ven Institute. The neighborhood also has educational institutions: the Kyiv Professional Pedagogical College named after A. Makarenko, the International Institute of Business, the Faculty of Information Technology at Taras Shevchenko National University of Kyiv, schools, and others. This social infrastructure meets the needs of the population by offering a sufficient number of places in schools, hospitals, and kindergartens. The district also has a significant number of government institutions, which indicates its business character. These include the Ministry of Infrastructure of Ukraine, the Northern Appeal Economic Court, and the Education Department of the Shevchenkivsky District Administration. The Bureau of Economic Security of Ukraine, the State Inspectorate of Educational Institutions, and the Main Directorate of the State Fiscal Service in Kyiv.

In addition, an important indicator of the neighborhood's development is the level of commerce. Although the map does not show a significant number of commercial objects, most of the ground floors in new residential complexes are rented for commercial use, as well as the ground floors in buildings on transit streets. Significant areas occupied by social and government institutions, office buildings, are concentrated mainly on the territory of the automation plant and near the Lukianivka metro station, on the former territory of the Artem plant. The analysis of cartographic information shows a high level of development of the studied area, which is confirmed by significant demand for real estate and diverse infrastructure. However, to meet all the local population's needs, the commercial sector may be expanded, with the construction of office buildings or multifunctional innovative centers. To gain a more detailed understanding of the situation, a sociological survey was conducted to study the comfort level of life and residents' attitudes towards transformations on the Kyiv Automation Plant site. The survey involved people living within a one-kilometer radius of the area. The respondents were aged between 26 and 44 years (70 %), and all had higher education. Regarding economic activity, 70 % of those surveyed are employed, with 60 % having an average income level. About 40 % work as individual entrepreneurs, 10 % in manufacturing, and 20 % in various sectors. The income level of the respondents, especially the younger ones, was predominantly average or higher, while pensioners considered their income insufficient. The survey reveals that a significant portion of the district's population consists of wealthy, mostly young people living in new residential complexes and using the area primarily as a transit space. They rely on the infrastructure within their residential complexes. For this group, it is important to ensure the development of high-level service infrastructure and recreational areas. For less affluent residents, it is necessary to provide access to quality playgrounds, recreational areas, and transport conveniences. To identify the infrastructural needs of residents, they were asked about their satisfaction with local institutions and services. All respondents noted that their daily needs are mostly met locally, and they do not need to travel often. However, respondents pointed out the lack of parks, sports facilities, cultural institutions, and various commercial establishments. Residents with higher incomes expressed a desire for more dining establishments and green spaces. Also, 40 % of those surveyed expressed a need for an additional business center due to high demand for workspaces in the area. The main issues identified by residents of the studied area are the parking of cars on sidewalks, which complicates pedestrian movement, especially on Sholudenka Street. In addition, the road surface condition leaves much to be desired, and the infrastructure does not meet the needs of people with disabilities. Additionally, residents pointed out

the insufficient number of open public spaces due to numerous closed residential complexes, as well as noted the low level of greenery and a lack of recreational areas. Another important issue is the safety of the district, which 60 % of respondents rated 9–10 out of 10, although some noted that ensuring full safety during martial law is impossible. The level of transport infrastructure was also rated highly – 80 % of respondents gave it 9–10 out of 10, thanks to the presence of two metro stations and an extensive surface transport network, especially along Beresteiskyi Avenue, providing convenient access to work. The survey revealed interesting data about residents' awareness of the Kyiv Automation Plant: 40 % of young respondents were unaware of its existence, even though the plant's buildings are visible from the road. Over 20 % expressed indifference to the condition of the facility, but after being informed about the specific abandoned workshops, 50 % of respondents expressed dissatisfaction with their condition. This suggests that closed development and the terrain of the area limit the visibility of the factory buildings, and residents of closed residential complexes often do not have direct contact with the industrial site. Unlike the younger population, older people were generally aware of the factory. Regarding the future of the abandoned workshops, 50 % of those surveyed expressed a desire to see new objects in their place, such as office buildings, an innovation center, or co-working spaces, which could provide additional jobs. Another 40 % supported the idea of creating green zones, while 30 % favored dining establishments, a shopping center, and service enterprises. This reflects a significant interest among residents in improving accessibility to various services.

Given these suggestions, it can be concluded that a comprehensive revitalization of the area is necessary, particularly the creation of multifunctional spaces with co-working areas, office premises, and commercial establishments to increase the number of jobs. The first problematic area, located in the courtyard, could be transformed into an innovation center that would connect with the revitalized business center "Vector". This would create a large green public space with free access, where employees and residents could relax. The second problematic area requires the demolition of a dilapidated workshop near the road. After which a view could be opened onto another abandoned workshop, suitable for conversion into a business center with a commercial ground floor, oriented towards dining establishments. The area along the road should be arranged as a small park zone with greenery, resting areas, and a children's zone. This would attract both residents and employees of the "Kubic" business center and neighboring commercial establishments. This approach will contribute to the increase of green plantings, expansion of public spaces, and improvement of the quality of life in the district (Fig. 5).

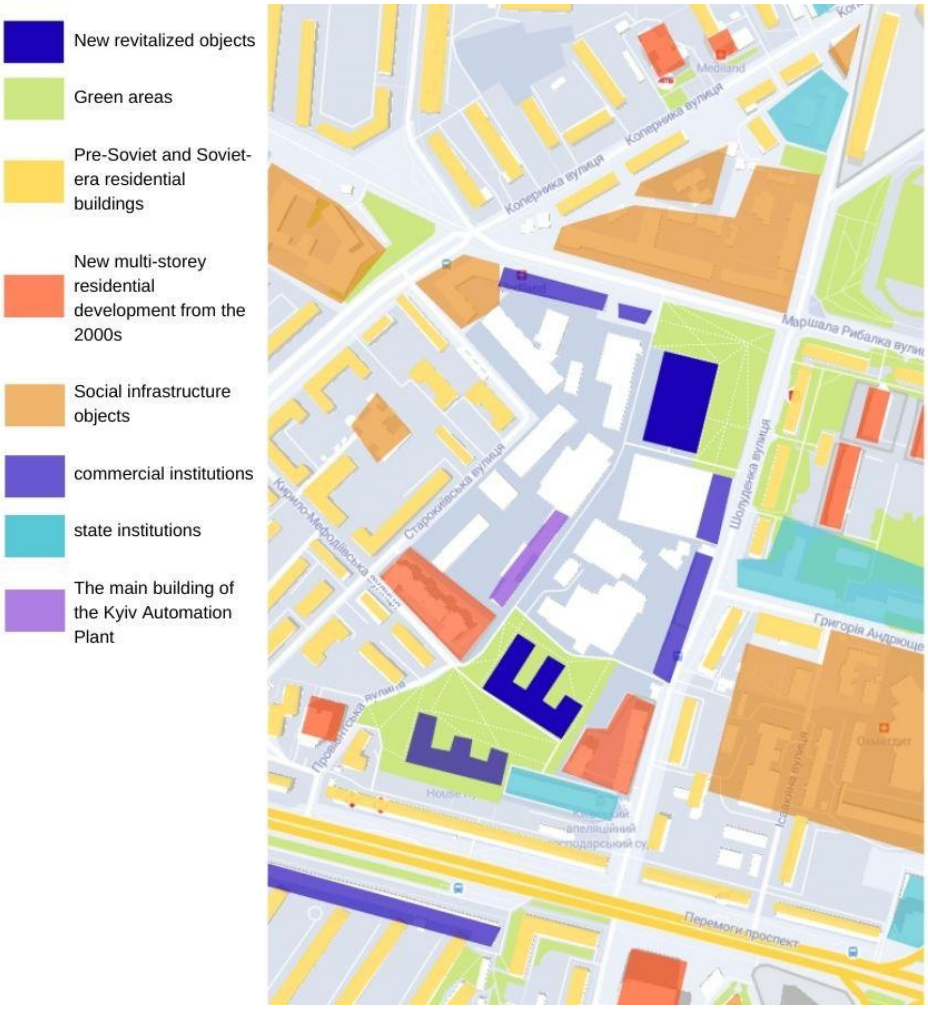

Fig. 5. Map of the project zoning and re-profiling of the automation plant

Discussion and conclusions

The revitalization of industrial areas in Kyiv is becoming an important aspect not only for preserving industrial heritage but also for promoting overall urban development. Transforming these areas into business, residential, or cultural spaces opens up opportunities for growth and improves the quality of life for local residents. One of the key advantages of this process is the transformation of abandoned urban areas into commercially viable properties, which can reduce crime rates and improve the standard of living in the district. Another advantage is the potential to create new jobs and attract new businesses, particularly in residential areas, through the development of new industries based on former industrial sites. Repurposing old industrial buildings into modern office spaces creates an environment conducive to the growth of innovative companies and startups, contributing to the development of the city's business ecosystem. Urban renewal associated with reconstruction can catalyze the development of city infrastructure. New office spaces, oriented towards innovative technologies and enterprises, require improvements in transportation accessibility, water supply and sewage systems, electrical networks. As well as the creation of recreational areas, parks, and urban gardens, which will enhance the quality of life for residents and workers in this area. Furthermore, some industrial objects may have significant historical value and could be repurposed into cultural centers or museums, preserving the city's historical memory.

Revitalizing industrial areas is a complex process that requires thorough analysis and effective land-use planning. Key challenges include high financial costs, changes in urban planning, historical and cultural constraints, corruption, and often chaotic development. While it is impossible to solve all problems quickly and easily, improvements are achievable. High costs and financial issues can be addressed through government and local subsidies, partnerships with private investors and funds, as well as phased project implementation. Urban planning changes require close cooperation with local authorities and planners to prevent chaotic development that benefits only investors without adequate infrastructure, and to adapt projects to urban planning requirements. Corruption issues should be addressed at the state level through management reforms and enhanced control by the State Architectural and Urban Development Inspection. Regarding historical and cultural constraints, it is important to develop special protection plans and involve experts in preserving the historical character of buildings. During revitalization, it is also important to consider aspects of sustainable development, such as energy-efficient buildings, the use of eco-friendly materials, and the preservation of green spaces.

Thus, successful revitalization of industrial areas in Kyiv requires a comprehensive approach that considers various territorial aspects and involves a wide range of professionals from different fields. Modern urban environments, particularly Kyiv, face various challenges such as the need to develop businesses, improve residents' quality of life, optimize space, and improve environmental conditions. To address these issues, it is essential to implement revitalization measures aimed at reconstructing and transforming industrial areas into zones with diverse functional purposes.

Kyiv already has examples of successful industrial area revitalization. Central districts demonstrate the highest level of adaptability to transformation, indicating their repurposing into business districts with a large number of commercial enterprises. In contrast, peripheral residential areas exhibit slower development dynamics, making them potentially favorable for transformation. The Solomiansky district, with its high population density and relatively central location, is among the areas with the greatest potential for attracting investment and creating new jobs. The Desniansky, Dniprovsky, Sviatoshynskyi, and Darnytsky districts are the most problematic and potentially lucrative for revitalization measures due to their characteristics as residential areas with large populations but few job opportunities. These areas require projects aimed at stimulating entrepreneurship and business activity. The development of innovation centers, multifunctional office complexes, and IT hubs will stimulate growth in peripheral districts, while revitalization in central districts should focus primarily on social infrastructure and the development of green spaces. For example, repurposing areas into park zones or squares can increase the number of public spaces and contribute to their appropriate greening.

Revitalizing Kyiv's heritage is defined not only by the desire to preserve the past but also by a strategic vision for the future of the city. This process does not simply restore objects but transforms them into modern spaces that become key factors in the development and cultural identity of Kyiv. Thus, revitalizing urban spaces is a necessary element for the sustainable development of urban environments, and its successful implementation will address many of the contemporary challenges faced by cities worldwide.

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РЕВІТАЛІЗАЦІЯ ПРОМИСЛОВИХ ТЕРИТОРІЙ: ДОСВІД МІСТА КИЄВА У ВІДНОВЛЕННІ МІСЬКОГО СЕРЕДОВИЩА

В с т у п . ***Київ, як столиця України, стикається із проблемою занедбаних промислових зон, які негативно впливають на міський ландшафт, економіку та екологію. Процеси ревіталізації можуть стати ключовим елементом для сталого розвитку міста у майбутньому. Стаття покликана дослідити сучасний стан промислових зон, їхній потенціал для трансформації та основні напрями ревіталізації.***

М е т о д и . ***Дослідження базується на комплексному підході, включаючи аналіз статистичних даних, вивчення успішних кейсів і польових досліджень. Для проведення дослідження ревіталізації промислових територій застосовується комплексний підхід, що містить такі методи: аналіз документів, польові дослідження, картографічний аналіз, соціологічні опитування, порівняльний аналіз, економічний аналіз, екологічна оцінка.***

Р е з у л ь т а т и . ***Проаналізовано економічні, соціальні та екологічні аспекти процесу ревіталізації з метою виявлення перспектив для різних територій. На основі даних запропоновано стратегії для розвитку різних районів міста, враховуючи їхню специфіку. Аналізуючи українські й закордонні джерела, було досліджено соціальні та економічні вигоди, пов'язані з ревіталізацією, зокрема створенням нових робочих місць, розвитком бізнесу, зниженням рівня злочинності й підвищенням якості життя. Основними проблемними моментами залишаються фінансові витрати, корупція, а також незацікавленість влади.***

В и с н о в к и . ***Подано стратегії оптимального використання міських територій шляхом ревіталізації з екологічних і соціальних аспектів. Важливо, що ревіталізація дозволяє зберегти історичну спадщину, забезпечуючи при цьому стабільність розвитку Києва. Результати дослідження можуть послужити основою для подальших проєктів ревіталізації міських територій в Україні, сприяючи покращенню міського середовища та інтеграції сучасних практик у міське планування.***

К л ю ч о в і с л о в а : ***ревіталізація, реновація, промислові території, сталий розвиток, Київ, міське планування, браунфілд, адаптивна трансформація.***

Автори заявляють про відсутність конфлікту інтересів. Спонсори не брали участі в розробленні дослідження; у зборі, аналізі чи інтерпретації даних; у написанні рукопису; в рішенні про публікацію результатів.

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