Future Cities and Environment

Architectural Renovation of Industrial Buildings on the Example of Large Cities of Kazakhstan

TECHNICAL ARTICLE

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ubiquity press

ABSTRACT

The realities of the modern city dictate the conditions for the expansion of human habitats. A number of industrial buildings erected in the last century occupies large territories, often in the center of cities. This causes environmental and aesthetic problems. In the historical centers of large cities of Kazakhstan, the problem of industrial zones renovation is especial urgent. At the same time, it is necessary to consider the economic feasibility of such activities, their profitability, and ways to preserve the architectural ensemble of historical buildings. Moreover, one of the fundamental factors is the psychological component, that is, the need to preserver the history of industrial buildings. At the same time, it is necessary to modernize and renovate enterprises, move production out of the city, and preserve existing buildings, changing their function to a more relevant one, while forming a unique ecosystem. To resolve this issue, a government program of Kazakhstan was considered, which in every possible way contributes to the renovation policy. However, for its optimal implementation, it is necessary to consider economic aspects, select the best ways and methods of renovation, and also study foreign experience, critically compare it with domestic renovation projects and formulate recommendations necessary for the renovation of industrial buildings.

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KEYWORDS:

traditions; urban environment; industrial area; sustainable development; modernization

TO CITE THIS ARTICLE:

Amangeldikyzy, R, Amandykova, D and Tokayuk, A. 2023. Architectural Renovation of Industrial Buildings on the Example of Large Cities of Kazakhstan. *Future Cities and Environment*, 9(1): 6, 1–15. DOI: https://doi.org/10.5334/fce.172

INTRODUCTION

To consider the issue of industrial buildings renovation, it is necessary to realize the inviolability of the architectural and construction complex that has developed over the entire history of the existing metropolis (Ahern et al., 2006). Since the architectural component makes it necessary to take into account not only the pragmatic components of industrial buildings and structures, but also directly historical, aesthetic, psychological parameters that should fit into the architectural ensemble of the existing conglomerate (Karim et al, 2020). In the already established urban system, which combines city-forming enterprises and human habitats (dormitory areas), which were directly built around industrial complexes, there are three main ways to carry out the reconstruction of a dilapidated industrial fund (Maniero & Fattori, 2021):

1. Removal of industrial facilities outside the city, subject to conditions and restrictions, including urban planning and environmental standards, complete demolition of the existing industrial complex and change of purpose of the land plot with its subsequent development (Figure 1).
2. Reconstruction in an already established industrial area, without changing the purpose of the territory, but by modernizing the existing enterprise, taking into account current aesthetic and practical requirements (Figure 2). At the same time, the optimal scheme consists of four components: 1. activation, 2. accumulation, 3. investment, 4. redesign.
3. Direct renovation of degrading territories with the cessation of the enterprise activity in the historically developed territory and adaptation of existing buildings and structures for further use by changing its functional purpose for the benefit of the metropolis (Figure 3).

The economic component greatly increases owing to the costs of demolishing existing buildings and structures, cleaning the adjacent and underlying terrain, mass dismantling of large-scale nodal structures, transferring numerous urban engineering networks (Nefedov, 2012). At the same time, many buildings are architectural monuments of various categories of significance. Accordingly, in order to preserve the architectural ensemble of the city and improve the ecological

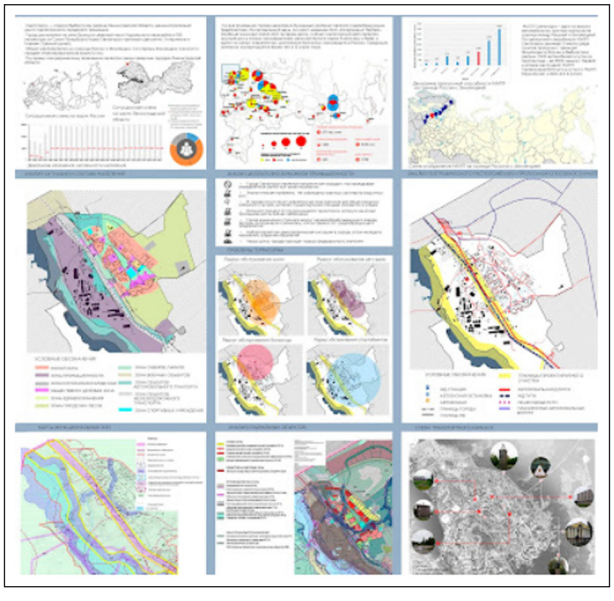

Figure 1 Scheme of moving industrial facilities out of the city.

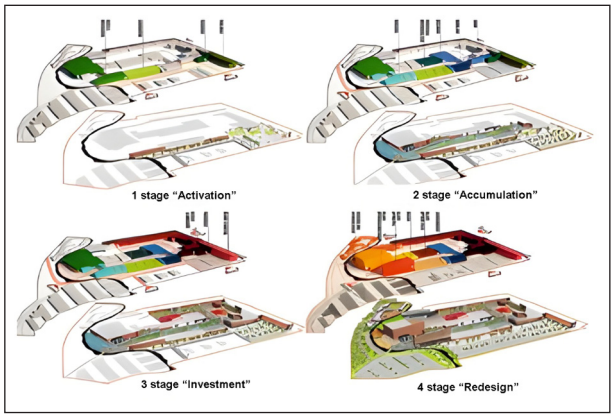

Figure 2 Scheme of the existing industrial territory reconstruction without changing the territory purpose "Redesign".

Figure 3 Scheme of the existing industrial territory reconstruction without changing the purpose of the territory.

situation in the region, it is necessary to apply the third way of reconstruction, namely, to use direct renovation measures, choosing its new functional possibilities. The transformation of industrial territories through renovation has three vectors (Clément, 2007):

1. Preservation of the industrial part functionality, which involves the preservation of the original appearance of structures and buildings, while a complete restoration process is carried out in with the restoration and preservation of technological tools, or replacement with analogues.
2. Re-functionalization is a partial change in the functional purpose of buildings and structures. At the same time, there can be the segmental or combined introduction of new subjects into historical and industrial territories, with an emphasis on the importance of the original functionality.
3. Complete re-functionalization is a fundamental change in the purpose of buildings and structures. Such a decision requires the largest coordinating part of the architectural and urban planning authorities and inspections in accordance with the social and cultural needs of the urban community (from industrial buildings to cultural and entertainment centers, hotels, catering establishments, commercial and office centers, sports grounds and facilities). This direction also includes ecological renovation (rehabilitation) with the creation of new green areas instead of dilapidated enterprises.

The most relevant renovation technique is a constructive implementation, that is, the integration of the reconstructed territories into the existing architectural ensemble and their adaptation to residential development with possible synergism of the territory properties, which positively affects the urban environment (Tsitman & Bogatyreva, 2015). On the example of the industrial buildings in large Kazakhstani cities, it is necessary to note the huge influence of historical heritage on the cultural specifics of the reconstructed territories.

During the reconstruction of industrial buildings and structures, most of which were built during the period of the country industrialization in the 1930–1960s of the last century, the architects had to adapt and harmonize the dilapidated industrial fund to the basic needs of the modern resident of Kazakhstan. Moreover, they also had to take into account the centuries-old cultural heritage when introducing renovations (Smailova, 2009).

In accordance with Article 31 of the Law of the Republic of Kazakhstan "On self-government activities in the Republic of Kazakhstan and on public administration", Decree of the Government of the Republic of Kazakhstan dated December 31, 2019 No 1054 "On approval of the State Program for Housing and Communal Development "Nurli Zher" for 2020–2025", the self-government bodies of all major cities of Kazakhstan decided to adopt the Housing Renovation Program for 2022–2025, analyze the industrial fund state and, if necessary, to carry out renovation of the industrial fund. In pursuance of the tasks outlined by the Government of the Republic of Kazakhstan, the key aim of this work is to develop scientific and practical justifications for the renovation of industrial buildings in large cities of Kazakhstan.

According to the goal, the following tasks are defined:

1. To systematize the factors that determine the renovation of industrial enterprises and ways to implement them.
2. To analyze the Kazakh and foreign experience in the reconstruction of industrial areas.
3. To assess the current technical condition of the Republic of Kazakhstan industries to determine the scope of the proposed renovation.
4. To define priority areas to improve the efficiency of reconstruction activities in Kazakhstan.
5. To propose methods to improve the efficiency of renovation of the re-functionalization of dilapidated stock.

MATERIALS AND METHODS

Despite the relevance of the problem, there are certain difficulties with the effective management of investment projects for the modernization of the old fund. For example, there is no effective mechanism that allows for the renovation of unprofitable enterprises. To develop a progressive management system and implement such projects, extensive scientific research, statistical analyzes, and numerous economic justifications are required (Fleming & Hayuth, 1994).

A theoretical base of this research is the scientific works of Kazakh and foreign scientists on the problem of the industrial and land fund renovation and the general economy. Laws and Decrees of the Republic of Kazakhstan in this area were used as a legal basis, while the data of the Agency of the Republic of Kazakhstan on statistics, economic and statistical reporting of industrial enterprises served as a source of statistical data.

The Republic of Kazakhstan is a state with large natural reserves. Yet, it is important for the Republic of Kazakhstan to minimize the dependence of the economy on the number of extracted minerals and bring it to a qualitatively new level through innovative development and technology renewal. Despite a number of adopted strategic documents and targeted programs, the introduction of diverse concepts aimed at industrial and innovative development, the country has not achieved great success in this sector. On the contrary, according to statistics, there is an increase in export volumes of

mined mineral raw materials, which means that the economy remains resource-dependent (Smailova, 2009; Abdiev, 2005).

Today, significant economic growth is based not only on the dominance of high-tech mining and processing industries. It is influenced by such factors as the urban environment, living and working conditions, the level of general literacy, a fair competition, a comfortable microclimate for investment, intellectual and technical innovations, the growth of human and social capital (Omarov, 2009). Accordingly, in the economic sector, the role of modernization of industrial facilities, which previously actively dominated the economy, is significantly increasing. For example, half a century ago, many factories were built in close proximity to residential areas. However, today they are a source of environmental pollution and have lost their town-planning dominant. Thus, the prospect of reusing previously unsuitable territories that have lost their economic significance solves several problems at once. Thus, the state can receive significant environmental and social profits due to the successful re-functioning of depressed lands (Nefedov, 2012).

The choice of the target function and the development of the object economic model is the main component of renovation. In order to analyze qualitative and quantitative indicators of manufactured products, the method of mathematical modelling was used (Abdiev, 2005). During the planning of renovation activities, mathematical modelling makes it possible to:

- identify and mathematically describe the most important relationships between economic parameters and physical functions of objects based on the formalization of the problem and limiting circumstances;
- obtain mathematical data describing the main economic functions inherent in the modernized enterprise and calculate the primary figures for the effectiveness of the planned renovation;
- using methods of mathematical statistics and inductive methods to obtain the missing data about the new function of the object, verify its shape, standard integrators into a variable state and the main dependences of variables obtained, including during observations;
- rationally present the data obtained as a result of mathematical analysis and clearly formulate the results of the planned re-functionalization of the object.

The optimization of the mathematical model and, in particular, the construction of a homogeneous model based on linear programming is of particular importance when performing a mathematical analysis of industrial facilities and in determining the feasibility and effectiveness of renovation measures. Linear homogeneous systems are simple and can be easily converted to any standard canonical or simplex form. At the same time, they make it possible to verify and compare the advantages of various options for transforming objects of economic activity (Pathiraja & Tombesi, 2023).

Mathematical modeling involves the formulation of an optimization problem from a verbal form into a mathematical one. Accordingly, it is carried out in several stages. The first and is the formalization of the problem. It involves the introduction of variables to describe the target task and set restrictions (Ospanov, 2005). Next, the optimization criterion is formalized and the expression of goals is written as functions of several variables, indicating the allowable maximum and minimum. And at the final stage, the relationship between the desired and permissible restrictions is identified, and the system is built. The obtained mathematical result is translated into specific abstracts and final recommendations are developed on their basis. Yet, it should be considered that for an objective and adequate assessment of economic factors and socio-economic processes, one should not forget about the use of econometric models and studies (Strazhev et al., 2003).

The main criteria for the system optimal design are as follows (Voropaeva, 2004):

1) Maximum profit.
2) Restoring the unity of the socio-economic space of the Republic of Kazakhstan by intensifying infrastructure improvements, strengthening and optimizing horizontal ties at the interregional and regional levels.
3) The abolition of economic inter-regional inequality and the introduction of the practice of territorial "attachment" of capital.

While maintaining an authentic and holistic architectural appearance, it is possible to bring buildings and structures to the norms of current domestic and international standards. Thus, the implementation of measures for the renovation and refunctioning of the industrial fund is the optimal solution for the technical re-equipment, modernization and re-profiling of the existing industrial base. Moreover, with the right approach and rational use of material and human resources, it is possible to save jobs, create socially important objects of urban infrastructure: from catering to entertainment centers (Ermolovich, 2001; Maslukhin, 2013).

RESULTS

The fact that the renovation, refunctioning and reconstruction of industrial facilities is a promising and

cost-effective solution was not immediately realized (Frolova, 2013). However, the first such experience demonstrated the economic efficiency of such projects.

The renovation of depressed areas can provide a significant impetus to economic growth in a particular region and improve the social and living environment for residents. This is frankly evidenced by statistical data after the reconstruction of old and dilapidated buildings into urban infrastructure facilities. Thus, Table 1 shows the depreciation indicators of fixed assets in the period from 2004 to 2008, and we see that the figures are growing every year.

At the same time, the reconstruction, though a complex, financially costly and labor-intensive event, can radically change the situation and eliminate losses from the maintenance and disposal of worn-out buildings. In addition, reconstruction can be carried out:

- with full or partial re-functioning of objects and territories;
- with the complete personnel withdrawal and the residents' resettlement;
- with selective and complete dismantling and removal of devices and equipment (Maniero & Fattori, 2021).

In any case, the basis for renovations should be an expert opinion based on a technical and economic assessment of the prospects of the industrial and land fund of the enterprise. All decisions and approvals are activated and endorsed by the management of the relevant authorities.

If we analyze the fixed assets state of enterprises in the Republic of Kazakhstan in the period from 2004 to 2008 based on the data in Table 1, we will get the following statistics. 20% of the total share of industrial enterprises corresponds to the absolutely worn-out fund, and more than 32% corresponds to machines, units and other equipment. This is despite the fact that the own costs of production for the implementation of major repairs are approaching 40% of all investment funds.

The data of Table 2 also tell for the renovation prospects, which allow us to operate with the parameters of fixed assets renewal coefficient (hereinafter referred to as the coefficient). Thus, at the end of 2008, the coefficient was 13.3% for the agricultural sector, 13.9% for the industrial segment, 33.6% for trade, 21.8% for the general construction market and only 14.9% for communication and transport. At the same time, the maximum liquidation rate was noted in agriculture (16.1%) and in construction (2.6%). Such statistics speak frankly about the lack of renewal of industrial and production assets and demonstrate the fixed assets depreciation critical level, the inefficiency of management and the inability of enterprises to allocate resources for the development of new products and the introduction of new technologies.

FIXED ASSETS BY INDUSTRY	YEARS				
	2004	2005	2006	2007	2008
All fixed assets	473 542	687 102	755 585	921 156	1 237 041
Mineral industry	191 596			274 703	497 345
Coal, lignite and peat mining	2 971	3 906	8 133	6 932	8 000
Extraction of crude oil and natural gas; provision of services in these areas	177 562	169 951	223 312	233 172	448 976
Iron ore mining	2 909	3 854	1 386	9 704	11 227
Mining of non-ferrous metal ores	6 056	8 454	14 980	16 843	20 486
Manufacturing industry	54 078	73 101	105 701	130 563	152 053
Food production, including beverages	12 066	14 857	18 957	25 832	26 588
Textile and clothing production	886	1 438	1 578	1 677	1 949
Manufacture of leather, leather goods and footwear	89	219	107	177	427
Manufacture of wood and wood products	125	245	485	652	711
Manufacture of paper and cardboard and products from them	2 161	608	1 085	1 523	995
Chemical industry	1 180	1 331	2 387	4 231	2 889
Metallurgical industry	933	1 539	2 387	4 399	3 312
Production of iron, steel and ferroalloys	8 315	10 674	14 098	18 121	20 493
Production of non-ferrous metals	15 174	17 795	30 025	22 291	37 147
Manufacture of machinery and equipment	1 477	1 663	2 189	4 377	4 332

Table 1 Data on the level of fixed production assets depreciation in the Republic of Kazakhstan (2004–2008).

FIXED ASSETS BY INDUSTRY	YEARS				
	2004	2005	2006	2007	2008
All fixed assets	13.2	15.4	15.5	17.5	18.6
Mineral industry	11.9	12.7	13.7	21.2	22.9
Coal, lignite and peat mining	6.9	9.5	4.4	4.9	5.8
Extraction of crude oil and natural gas; provision of services in these areas	12.2	12.4	14.0	22.0	23.5
Iron ore mining	13.0	13.7	8.3		20.3
Mining of non-ferrous metal ores	11.2	18.2	13.3		19.1
Manufacturing industry	18.1	17.9	17.9	17.9	14.7
Food production. including beverages	17.1	16.6	19.2	19.1	14.3
Textile and clothing production	22.4	44.5	13.5	15.8	3.6
Manufacture of leather, leather goods and footwear	8.1	27.6	1.2	6.9	10.7
Manufacture of wood and wood products	16.7	27.4	54.2	32.2	21.9
Manufacture of paper and cardboard and products from them	12.5	17.7	1.5	10.0	12.8
Chemical industry	32.9	28.9	13.1	9.9	4.1
Metallurgical industry	17.2	16.7	14.2	20.4	18.1
Production of iron, steel and ferroalloys	21.4	12.0	9.6	11.7	11.4
Production of non-ferrous metals	11.7	22.4	15.9	23.6	17.7
Manufacture of machinery and equipment	16.2	11.6	26.2	17.3	17.9

Table 2 Statistical coefficient of renewal of fixed assets in the Republic of Kazakhstan 2004–2008.

In many respects, the situation with a high degree of depreciation of fixed assets and a low level of technical re-equipment is caused by the lack of initiative of the management of the enterprises themselves (Pathiraja & Tombesi, 2023). They should consider mechanisms to improve the efficiency of technology, reorganize the staff and optimize production. The state, in turn, stimulates these processes with investments, tax incentives and other preferences (Brocard et al., 1995). The policy of the Republic of Kazakhstan on industrial activities is aimed at creating conditions for increasing the scale of production, ensuring the competitiveness of products, the effective implementation of import substitution measures, improving the environmental situation and increasing science-intensive technologies.

However, when planning measures for the renovation optimization of cities and conglomerations, it is necessary to proceed from historical and national-cultural traditions. The problem is exacerbated by the fact that the intensive growth of urbanization of the last century was closely associated with the creation of an industrial base, so enterprises are often located almost in the central areas of cities. The preservation of the historical architectural appearance is an important aspect of any renovation project, and some architects are so careful about history that they introduce a whole range of measures to preserve a unique architectural element (Solrain et al., 2019; Cabrera García, 2022).

Refurbishment of industrial facilities of special historical value is a key direction in urban architecture development and formation (Solrain et al., 2019). This capacious and complex field of activity includes a whole range of areas: cleaning up depressed areas, developing the concept of creating museums, creating accents using architectural methods, and so on. In modern similar practice, two key directions have clearly formed: in the first case, transformations mainly concern the functional purpose of the object, in the second, more complex programs are implemented to change the architectural component (Sanko, 2015).

For clarity, let's consider the reconstruction and renovation of Kazakhstan and start with the projects implemented in Almaty. One of the first renovated objects was the Almaty Cotton Mill, built back in the 70s of the last century. In the new millennium, the critical decline in production ended with a phased reconstruction of all buildings and structures of the Almaty Cotton Mill. So, today there is a trading house "ARMADA" in one of its buildings. Figure 4 allows you to evaluate the sequence of transformations of an abandoned building into an operating enterprise (Smailova, 2009).

The Almaty House-Building Plant (AHBP) built on the banks of the Bolshaya Almaatinka River back in 1956, had to go through a similar reorganization (Figure 5). With the onset of the 90s, it loses its significance and completely ceases its activities, which were mainly aimed at panel

Figure 4 The results of the Almaty Cotton Mill renovation.

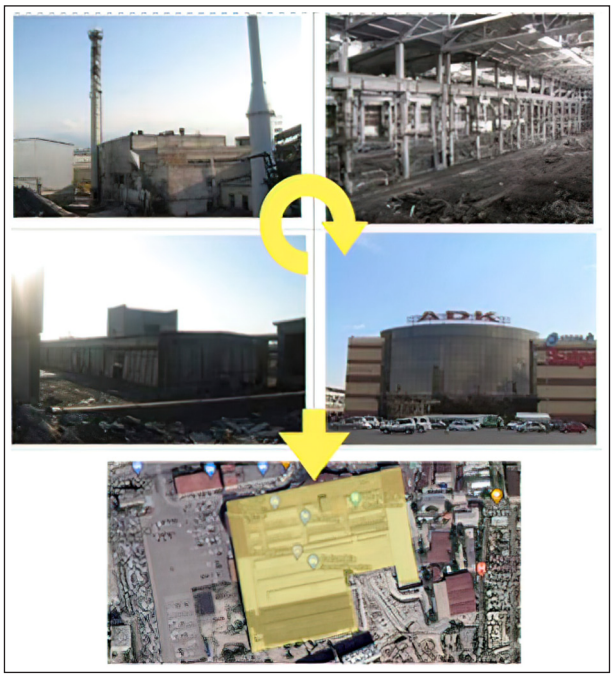

Figure 5 Renovation of the Almaty House-Building Plant (AHBP).

housing construction (Nysanbaev & Burkitbay, 2004). After the bankruptcy, all AHBP buildings were sold. Already at the end of 2011, a new shopping and entertainment complex with the identical name AHBP were opened in its place. The style of architectural solutions, the design of the exterior and interior of the shopping mall "AHBP" were made by LLP "Design Institute Apmatygiprogor-1", GAP Sharapiev Zh.N. The chronology of the phased renovation of the AHBP is shown in Figure 9.

Another object of industrial heritage is the Almaty Fruit Canning Plant. The plant was founded in 1936. In 1993, it was withdrawn from state ownership and transformed into a joint-stock company. In November 1999 it was liquidated. Its vast areas proved ideal for modern hypermarkets, and today its warehouse building are used for the storage of finished products houses the "Arzan" low-price supermarket. This is a one-story, three-span building. The load-bearing frame is made of prefabricated reinforced concrete structures. At the reconstruction stage, the partial replacement of utilities and the installation of commercial equipment were carried out. Figure 6 shows how the renovation took place.

Almaty Electrotechnical Factory (AETF) The Almaty Electrotechnical Factory was established in 1941 on the basis of the Transsvyaz plant evacuated to Alma-Ata from Kharkov. The building before renovation is shown in Figure 7.

Its main administrative building stood abandoned for many years, the workshops were in deep conservation. In 2011, AETF began a second life: its administrative building was sold and rebuilt into the "Mart" shopping center (Figure 8).

Figure 6 The process of the Almaty canning plant re-functioning.

Figure 7 The AETF building before the renovation.

Figure 8 The AETF building after the renovation of the shopping center "Mart".

The Alma-Ata Carpet Factory was established in 1936 as a cooperative industrial artel "Carpet Maker" (Figure 9a).

In 1992, the Alma-Ata carpet factory was privatized, equipped with new German equipment and transformed into a private joint-stock company Almaty Kilem JSC. Since 2007, a shopping complex has been located here (Figure 9b).

Knitting factory named after Dzerzhinsky. This building belonged to the Alma-Ata knitting factory. This building was refurbished. Currently, the Almaty Financial, Legal and Technological College is located there (Figure 10).

Figure 9a Alma-Ata Carpet Factory.

Figure 9b Shopping complex "Almaty Kilem" after renovation.

Figure 10 The building of the Almaty Financial and Legal College after renovation.

Figure 11 shows the first production facilities of Alma-Aty Fur Factory. It was founded in 1938 as a saddlery and rawhide factory on the basis of a tannery, whose history dates back to the end of the 19th century. On the example of this building, we visually see the state of the territory, which requires renovation measures.

The need for renovation, the nature of the change in the traditional function of the building to an alternative one is determined by many factors of a social, economic, psychological, historical, aesthetic nature. To minimize the negative impact on the environment, most industrial enterprises are transferred outside the city or to remote areas of the region. Similar trends also have a positive effect on the decoration and contribute to more comfortable living conditions in megacities and small towns. However, there remains the problem of renovation and re-functioning of urban areas where the transferred enterprises were located.

As what it was said, we can consider the city of Turkestan. After the city became a regional center, the influx of citizens increased, which created a demand for housing stock and building materials. In 2020 alone, the city's specialized enterprises produced 40 percent more building materials than in 2019. Such socio-economic changes led to the construction of nine new factories of various profiles, led to the introduction of more knowledge-intensive innovations at all levels, the expansion of office space and the suppression of industrial buildings by expanding social infrastructure. Industrial zones are isolated, lose their functionality and relevance for the city and turn into unpromising areas (Nysanbaev & Burkitbay, 2004).

The social and economic reasons for the regeneration of industrial facilities were formed under the influence of the ambiguous political and economic processes taking place in our country and the world. Thus, the collapse of the Soviet Union and the independence of its republics provoked a break in economic ties and led to a mass stop of industrial lines of various enterprises, including in the Republic of Kazakhstan. Among the

Figure 11 Alma-Aty Fur Factory. Current state.

social factors influencing renovations, one can single out the improvement in the quality of life, the increase in the level of education, the formation of a new work and management culture of production processes (Sanko, 2015).

The plan-scheme of Turkestan, shown in Figure 12, very clearly demonstrates the intensive expansion of the urban area towards the industrial zone of the concrete mixing plant.

Urban planning reasons for the regeneration of industrial facilities are also diverse and are directly related to the growth rate and the specifics of urban infrastructure formation. Dynamics of the permanent population, flows of tourists and guests, planning, transport system, professional orientation, planned or chaotic zoning (Figure 12) – this is just a small list of urban planning factors that affect the territories renovation processes. The scheme of roads and features of the transport interchange caused certain problems for the movement of large-capacity transport in the residential areas of Turkestan.

As a result, a conflict situation arose between citizens, drivers and those living in private houses and a transition zone arose, which only aggravated the problem with its travel arteries and railway lines, which are sources of noise, physical barriers and require the creation of a sanitary zone. It hinders the development of the center due to the presence of industrial facilities and the exclusion zone along the railway track, and at the same time, it has significant potential for expanding the functionality of the territory as a result of an active flow of cars and trucks and a convenient location near the territorial center of the city.

All of the above mentioned has led to the irrational use of the land fund and the deterioration of the social situation. The best prospective development could be the refurbishment of the transition zone infrastructure with the creation of new structures and space remodeling. It is necessary to allocate sites for business and cultural activity centers, objects of social and cultural significance. With a competent approach, the creation of such structures in combination with the release of the railroad territory from chaotically erected buildings and convenient transport interchange will ensure a high level of interconnection between city districts and successfully solve compositional moments and environmental problems. But reconstructions are not always radical and large-scale. Sometimes simpler, but not less spectacular transformations without changing the functionality of buildings and structures fit well into the city architecture (Karim et al., 2020).

Figure 12 Scheme of the CDC territory development in Turkestan (colored areas – positive development, black areas – the zone of the industrial territory).

DISCUSSION

After studying the informative and thematic base and on the basis of the presented materials, it can be summarized that in Kazakhstan there are a considerable number of industrial territories and industrial facilities that require reconstruction or re-functioning in various ways. Optimization and modernization should take into account the peculiarities of the territory location in the urban infrastructure, the classification and specifics of production and industrial zones (Nysanbaev & Burkitbay, 2004). At the same time, the process of optimization and qualitative improvement of urban infrastructure is subject to several basic principles. Thus, urban planning principles for optimizing industrial zones a priori assume their orientation to urban urbanism and the need to introduce a certain structural or functional element in the zone of their location. At the same time, the main point is to meet the needs of the central, middle and peripheral zones (Cherkasov & Kabaeva, 2011).

In considering the current issue, four fundamental ways to optimize industrial and depressed areas can be distinguished inclusion, centralization, regeneration and redevelopment (Nysanbaev & Burkitbay, 2004):

1. Inclusion. It involves the optimization industrial areas introduction into existing buildings, which contributes to the addition, saturation of the functional and structural composition of the existing urban environment. The principle of inclusion is effective when the urban area is sufficiently developed and actively used, and the presence of industrial territory acts as an obstacle to the full functioning and life of society, and in addition, it causes difficult barriers and breaks transport and pedestrian routes. In such situations, optimizations should fit into the environment as comfortably as possible, create favorable conditions for possible functional unloading of nearby territories and rationally redistribute traffic flows, ensure the possible introduction of the necessary additional and auxiliary functions. Optimization inclusions are designed to increase the territory of recreational facilities, create comfortable conditions for the operation of objects of social and cultural significance (Proskurin, 2011). Thus, former industrial facilities can be preserved, provided that they harmoniously enter the building structure.

2. Centralization. Such optimization is aimed at the relatively independent functioning of the object as a result of the available convenient transport links and a well-organized internal communication structure that serves as a place of attraction for both residents and tourists of the city. Such an optimization of industrial areas can become not only a city landmark, but also gain worldwide recognition.
3. Regeneration. Purposeful use of the industrial zones optimization for temporary functions in order to improve the environment, further the full use of the territories. Allows you to most rationally implement the structural or functional content of the city limits. This method is applicable in extremely negative environmental conditions, which are caused by long-term exposure to harmful production. With insufficient funding, the regeneration method is also applicable, only in this case, on unpromising industrial territories, laconic recreational zones are created or an urban space is formed without fundamental changes in the external and internal content of the objects that make up the industrial zone (Zolotykh, 2017).
4. Redevelopment. It involves the reconstruction of abandoned lands, inefficient and unprofitable industrial facilities as part of a functional urban development. Although it can also be an adaptive use of old buildings and structures for residential and public facilities.

To illustrate the effectiveness and expediency of the above measures, let's consider a few examples from world practice. It should immediately be objectively noted that the experience of foreign architects involved in renovation projects is quite diverse and demonstrates not only the quality of the result obtained, the courage and non-triviality of the introduced ideas, but sometimes even banal alterations.

An intervening renovation project has been successfully implemented in Kharkiv (Ukraine). Its goal is the re-functioning of the flour mill building, after a long period of operation and dilapidation. At the same time, this object was not only successfully reconstructed with a complete change in functionality, but also formed the basis for the creation of a new philosophy of living in the area adjacent to it. The building before renovation is shown in Figure 13.

The history of this object renovation is ambiguous. The building itself was built in the middle of the 19th century and is an example of a monolithic-frame structure of those years. Since the completion of construction in 1886, it has housed a flour mill, which in the 60s of the XX century was renamed "Kharkiv Bakery Plant No1". Over time, the operation of the building became inefficient, the plant was closed, and the abandoned building began to gradually collapse. Already after 2010, the problem of demolition or flour mill renovation was raised more than once in the city. There were even proposals to rebuild it into an art center, but in the end, a project to optimize it for residential development was approved (Figure 14).

So, instead of an abandoned flour mill near the Kharkiv riverside, a new IT park with the unusual name Manufactura and a total area of 40,000 m^2 appeared. In fact, this complex combined in a single architectural ensemble 3 buildings of modern construction and the reconstructed premises of the bakery, which turned into a stylish six-story office center Space overlooking the beautiful embankment. The complex includes one-bedroom apartments, office space, an apart-hotel, a fitness center, an art gallery, a grocery market, a conference room, restaurants and service centers. This decision made it possible to preserve the historic building, use the city territory as efficiently as possible and ensure a qualitatively high level of social infrastructure. Another interesting and well-known project in the world is the renovation by architect Ricardo Bofill. It consisted of refurbishing an old factory building in Spain into a cozy apartment building.

The difference before and after the implementation of the project can be seen by comparing the Figures 15 and 16.

Figure 13 Unused building of the Kharkiv flour mill in Ukraine.

Figure 14 The result of the flour mill renovation in Kharkiv (Ukraine).

Figure 15 Factory Barcelona before renovation, Spain.

Figure 16 Former factory after a renovation project by architect Ricardo Bofill (Barcelona, Spain).

Figure 17 Large industrial building in an abandoned state.

As the next successful experience in the renovation of industrial facilities, we can consider the reconstruction of an industrial building in the Chinese city of Hangzhou (Figure 17).

This building has been reorganized into a high-quality hotel and office complex, which is shown in Figures 17–18.

Figure 18 Stylish hotel and office complex in the Chinese city of Hangzhou after renovation.

Figure 19 Famous Battersea power station after renovation.

Figure 20 London recreational area near Battersea power station after its renovation.

The inactive Battersea coal-fired power plant, located on the banks of the Thames in London, is another successfully implemented, successful project for the renovation of industrial areas and facilities (Figure 19).

You can evaluate the architectural and infrastructure solutions of the project in Figure 20.

The Battersea Power Station is one of the largest art deco red brick buildings in Europe. It consists of two symmetrical parts with 4 chimneys and, after renovation, appeared as an entertainment center with an architecture museum and viewing platforms on the roof, as well as office space, cozy cafes, restaurants

and attractions. To implement measures for the re-functioning of this industrial era facility, London authorities announced a competition in which the architectural bureau Atelier Zündel won. Today, thanks to the renovation, Battersea Power Station has become one of the most popular attractions of modern London. The daring renovation of the elevator into the Grünerlökka dormitory in Oslo can be safely called the most non-trivial project to change the functional purpose of an industrial facility (Figure 21).

Back in the middle of the 20th century, the elevator was actively used for its intended purpose. But when in the 90s the area of its location (and it is located almost next to the coastline of the Akerselva River) fell under a large-scale renovation project, which involved the creation of a large park and recreational area with the construction of cultural and educational facilities. In order not to demolish the elevator, it was decided to re-function it into a student hostel. As a result, the project turned out to be very unusual, but interesting – it created 226 apartments with a non-trivial layout and an area of about six meters in diameter. Another example of the development of industrial territories is the educational complex of Bergen University College. It is located in Bergen and is shown in Figure 22.

Figure 21 Grunerlokka dormitory – building of the former grain elevator.

Figure 22 The Kobling Complex at the University of Bergen.

The basis for the implementation of the renovation project was the building of the railway depot and warehouses, the ensemble of which was supplemented by new educational buildings and the administration building. Such a combinatorial solution, apparently, determined the name of the complex, which in Norwegian means “Connection”.

One of the renovation types is a museum exposition. In New York a glass museum was made from old, worn-out buildings of a glass factory, shown in Figure 23.

It is impossible to transform industrial zones and factory buildings into social infrastructure facilities, as well as to preserve historical buildings of the industrial era without significant capital investments. Large investments are required, both material and intellectual. In this regard, the authorities have high hopes for the owners of such structures and territories and for attracting promising investors. It is extremely important to understand that renovation is a unique opportunity to preserve the historical heritage, increase the level of the city, region and the republic as a whole economic development. The main thing is to correctly set priorities for rethinking the architecture and industrial development of cities and conglomerations, and to intensify investment flows in this direction (Omarov, 2009).

Unfortunately, in the last century of total industrialization, it was the norm to build factories, plants and even large plants within the city. And even if today they bring dissonance to the urban infrastructure and do not meet the real needs of society and the economy, demolishing them all is inexpedient, and incredibly costly. In addition, many of these buildings and structures are unique objects in terms of history and architecture (Ospanov, 2005). The harmonious neighborhood of old, restored buildings with new houses, office centers and entertainment complexes will allow rational use of territories, improve the ecological situation and increase the functional use of infrastructure, and as a result will lead to an improvement in the quality of life and the country’s economy to reach a qualitatively new level. Therefore, the experience of foreign architectural bureaus and design solutions of our compatriots are important for us. Their detailed analysis and detailed study of all social,

Figure 23 Museum of glass in New York.

economic and environmental aspects of the renovation will allow you to get the best result and turn abandoned and empty buildings into fully functioning household, educational, recreational and entertainment facilities (Ospanov, 2005).

CONCLUSION

We live not only at the turn of two centuries and two millennia, but we can personally observe how sometimes industrial society is being transformed into a post-industrial and information society. Naturally, this situation directly affected the state of the industry and led to a decrease in the growth rate of various products output. Given the increased dynamism of all modern social and economic processes, the result of the extinction of individual industries was not long in coming, and today we see how the once prosperous enterprises and industry flagships are turning into unpromising ones.

The instability and globalization of the world economy, a series of international crises and social upheavals, the instability of exports – all this negatively affects the economic development of the Republic of Kazakhstan. But internal factors are added to external factors: a decrease in production efficiency, a lag in the technological and intellectual base, wear and tear of equipment, and so on. To stabilize and improve the economic situation in the country, the leadership of the Republic of Kazakhstan have taken a number of measures to create a favorable investment climate, ensure fair competition and intensify scientific activity in many areas, among which were activities aimed at modernizing and reconstructing industry and individual industrial facilities. The implementation of such a policy has led to certain successful results in terms of modernization and re-functioning of the industrial sector.

Statistics show that among commercial structures there is a certain interest in renovation projects. The prospects of this investment direction can be judged by the number of applications for the issuance of titles of protection for industrial facilities, the volume of labor and intellectual resources involved, and the investment companies financing quantitative flows. However, the situation still leaves much to be desired. Thus, for the mass and more effective promotion of projects for the renovation of depressed areas and inactive industrial facilities, it is necessary to improve and adapt the regulatory framework, improve the material and technical equipment, again gain our own practical and diverse experience in this area, and better approach aesthetic and functional aspects when performing optimization, modernization and reconstruction of such projects.

But the most important thing that the effective renovation of industrial facilities is simply impossible without providing the necessary funding. Accordingly, a qualitatively carried out modernization is the basis that will become dominant for active economic growth. Modernization measures are designed to improve the economic field, comprehensively increase the profitability and energy efficiency of industry. These are extensive programs that include mechanisms to improve the quality characteristics of manufactured products and involve large-scale transformations in technological processes and technologies used, as well as the reorganization of labor and improving the efficiency of managerial management and social conditions for employees. The main methods for improving the tools and mechanisms for the modernization of modern production include:

1. Improvement of the material and technical base, which is costly. Accordingly, it is necessary to attract both public and private funds. One of the key sources of financing can be a repair fund, which must exist at each enterprise;
2. Organization of the process of introducing innovations. It should be carried out in stages: an increase in production capacity, reducing the optimization of production costs, saving material resources are made gradually and are implemented only after carefully planned and executed preparatory work for their implementation.

The concept of renovation and re-functioning of industrial zones, depressive lands and industrial facilities is of great importance for many cities and conglomerations of the Republic of Kazakhstan today. The study of advanced domestic and foreign experience will help to use the most successful examples in the transformation and re-functioning of objects of varying complexity and specificity. The prospect of industrial-industrial architecture lies in its uniqueness, increased adaptability to the intensive growth of urban infrastructure and various requirements for functional expansion. Moreover, non-standard layout and industrial design make it possible to introduce a variety of architectural techniques, harmonize the appearance of old and new buildings compiled in a single architectural ensemble and create new urban objects on their basis, which will indeed become universal points of attraction for the population, capable of attracting large-scale financial flows.

COMPETING INTERESTS

The authors have no competing interests to declare.

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TO CITE THIS ARTICLE:
Amangeldikyzy, R, Amandykova, D and Tokayuk, A. 2023. Architectural Renovation of Industrial Buildings on the Example of Large Cities of Kazakhstan. *Future Cities and Environment*, 9(1): 6, 1–15. DOI: https://doi.org/10.5334/fce.172

Submitted: 21 November 2022 **Accepted:** 06 March 2023 **Published:** 24 April 2023