The principles of identity in the renovation of industrial buildings in historical cities of Russia

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Abstract. The research was conducted in order to develop the principles of renovation of industrial buildings in historical cities of Russia, namely: Kazan, Samara, Voronezh, Nizhny Novgorod. These cities were selected based on their geographical location - all of them are located in the Volga region. Existing plants and factories, abandoned industrial enterprises were studied and systematized. Historical analysis was conducted to identify the specifics of industrial formations, as well as architectural and artistic analysis to study the architectural and planning composition of industrial formations in cities. Based on the analysis, the principles of identity of industrial buildings in Volga cities were identified. The practical significance of the work lies in the possibility of applying the research results in modern architectural practice, in particular in the renovation of industrial buildings in historical cities of Russia. This work can become the basis for further research, identifying valuable areas of development of industrial formations.

Keywords: renovation, industrial architecture, cities of the Volga region, identity, principles of renovation, architecture.

1 Introduction

The industrial revolutions that began in England in the eighteenth century and continued in Europe, then in Russia and around the world, defined a new frontier in the development of industry. The era of industrial development of the country with a large number of factories and increasingly expanding industrial territories, increase in volume and number of buildings and structures, a growing number of workers was replaced by an era of high technology, intellectual labor and minimization of production, which is called the fourth industrial revolution. The historic center formed on the river banks, is constantly growing, and it is captured by industrial enterprises, many of which are dilapidated and they need to find new meaning in the city. With the growth of the city, with an increase in the pace of housing construction and construction of administrative and business facilities, with the transition from industrial to science-intensive, technological production, today there is a need to reduce industrial areas, partially repurpose production buildings, renovation and other measures. Industrial enterprises are forced to become more flexible and adapt to the overall transforming urban infrastructure in order to avoid gradual degradation and decline. Formal industrial buildings were often created by well-known architects who specialized in complex design not only of the industrial facilities themselves, but also of their associated residential complexes and other associated buildings. After World War II, the approach to industrial architecture changed significantly. A large number of new facilities were built only with their functional purpose in mind and made from the cheapest available materials. Additional problems arose in the last decade of the twentieth century, when many industrial enterprises collapsed, causing the devastation and demolition of numerous facilities. Only
for a short time industrial buildings were treated as monuments and placed under the appropriate control and supervision of heritage keepers [1].

Special attention should be paid to buildings in the city center, since their location is itself a problem for the current situation. Former industrial territories are often abandoned, and if this problem is not given due attention, there is a risk of disappearance of unique objects of industrial architecture [2]. Many foreign architectural publications pay close attention to the renovation of industrial buildings. They focus on complex solutions for industrial areas with objects adjacent to urban centers, and the impact of industrial objects on the architectural and spatial composition of cities [3, 4]. European countries were the first to face the problem of deindustrialization of industrial centers due to the historically high concentration of regions of old development. In Europe, the relocation of some enterprises outside of major cities coincided with the recognized need for radical re-equipment and modernization. Several dozen old industrial districts have been formed on the European territory. The most famous among them are Manchester and Glasgow (Great Britain), Ruhr (Germany), Lille (France), Bilbao (Spain), and others [5, 6]. The reasons that led to the decline of industrial territories are highlighted:

– poor quality of existing residential and recreational areas in cities, a high proportion of industrial and warehouse areas in the central parts, and an unfavorable transport situation (the level of development of transport infrastructure does not correspond to congestion and does not keep up with the growth of the fleet);

– the ongoing processes of transformation of the city’s economic functions, the development of new technologies, the growth of population incomes and changes in their requirements make increasingly stringent requirements for the quality of the urban environment;

– the nature of urbanization has changed in the country, this is due to the fact that public capital investment in urban development has been replaced by private investment, which is subject to market laws and is focused on obtaining a rapid commercial effect [7].

According to James Douglas, renovation (adaptive use) is «any construction work and intervention to change its capacity function, or performance to adjust, reuse, or modernize a building to meet new conditions or requirements» [8]. The cities chosen for the study are located on the water line, which also plays an important role in the formation of industrial hubs. In the world practice, successful results of renovation of industrial zones located on the water line, such as London and Barcelona, are already known [9]. A project is currently being developed to renovate the Belgrade water line [10].

Bayraktaroglu, B., Arabacioglu, FP. «Process of Culture as a New Form of Production in Industrial Buildings: Buda Fabriek» examines the city of Kortrijk, Belgium, which is located by the river [11].

Biegańska, J. describes the activities carried out to solve the problems of post-industrial territories and objects, which can be divided into three main groups:

1. The protection of cultural heritage associated with the industry.
2. Improving the environmental situation, landscaping and land use.
3. Improvement (development) of post-industrial lands and objects of economic purpose [12].

In London, King's Cross is one of the largest redevelopment projects of a former industrial zone in Europe. The area of the district is just over 27 hectares. It used to be an empty industrial zone, but now new homes, shops, offices, bars, restaurants, and schools are being built here. Thanks to planning, the project has achieved a high BREEAM rating. The BREEAM international system based on the method of environmental assessment of building performance involves 3 steps to achieve the sustainability of buildings, including renovation projects:

Step 1: establish the development principle. At this stage, the BREEAM community structure highlights the potential for increasing site-wide sustainability. Step 2: Defining the development plan includes detailed requirements for how people will move around and through the site, as well as where auxiliary buildings will be located. Step 3: Detailed development project, including: design and specification of landscape design, sustainable drainage solutions, and vehicles [13, 14].

Asian countries also face the problem of renovation of old industrial buildings. For example, with the acceleration of China's industrialization process, the industrial production process has been optimized. Many old buildings could not adapt to the new production needs, and a large number of
industrial buildings remained idle [15]. Or in Hong Kong, when with economic restructuring in the 1980s and 1990s, most manufacturing plants were moved to China, and many industrial buildings were left abandoned or empty [16].

In Russia, the topic of renovation was also discussed [17, 18]. Russia has a fairly large number of industrial territories: from single-industry towns to small enterprises [19]. The former territories of factories, coal mines, shipyards, and power plants that used to be factors of regional development are now turning into a negative factor that worsens the socio-economic climate in rapidly changing economic conditions. In general, they create a negative image not only of the area where the former production facility is located, but also of neighboring districts, and sometimes of the entire city as a whole [18]. Spot renovation of an industrial enterprise in the historical city of Ulan-Ude was touched upon by Makotina S. She describes the renovation methods used in the project:

1) «Integration Method» is an embedding of additional elements and structures into existing building structures;
2) «Redesign» - a method that allows you to create a kind of composition from individual inserts or overlays, changing the planar plastic of facades;
3) Method of reconstruction of facades [20]. The theme of preserving facades is also described in the work «Building renovation adopts mass customization» [21]. Gaiduk A. R. also mentioned the methods that she used on the example of Kazan [22].

1.1 Problem Statement
Based on the above, it becomes urgent to prevent further internal and external degradation of industrial buildings, there is a problem of «improving» industrial formations, integrating them into the complex structure of the city, adapting these sections of the city to new urban planning and innovation processes. The need for a harmonious environment, increasing complexity, and multicomponent spatial environment of modern cities make the solution of this problem particularly necessary [13].

The purpose of the article is to generalize the experience of renovation of industrial enterprises in the historical urban structure and identify the principles of identity that contribute to the harmonious implementation of renovation in an industrial object.

Based on the research hypothesis and goals the following tasks were set:
- analyze the experience of renovation of industrial architecture;
- identify the main factors that affect the change of the urban environment;
- develop the principles of identity of renovation of industrial enterprises in historical cities of Russia.

2 Materials and methods

2.1 Research Process
Most often, industrial enterprises occupy large areas in the central districts of large cities. Most of the territory cannot be used for its original purposes. The high price of renting premises in the city center makes the situation even worse. Reconstruction of industrial premises located in a historical environment requires a special approach. The historical building is a concentration of many functions and architectural forms. Therefore, the clash between the old and the new in this environment becomes even stronger along with the acceleration of the historical process. Demolition is considered an extreme measure when it comes to the reconstruction of industrial buildings, and it is not justified either technically or economically [3].

Industrial enterprises (factories and plants) in historical cities of Russia (Kazan, Nizhny Novgorod, Samara, Voronezh) were selected as the objects of research.

2.1.1 The boundaries of the study
- the chronological boundaries of the study are defined by the beginning of the first industrial revolution (the end of the XVIII century) and before the beginning of the fourth industrial revolution (the beginning of the XXI century).
- the study's territorial boundaries cover Russian cities (Kazan, Nizhny Novgorod, Samara, Voronezh).

2.1.2 Main research methods
- study of existing industrial enterprises, generalization and classification of them;
- study and systematization of abandoned industrial enterprises;
- historical analysis to identify the specifics of industrial entities;
- architectural and artistic analysis for the study of architectural and planning composition of industrial formations of cities.

The study was conducted to identify the principles of identity of buildings in historical cities of Russia, namely in the Volga region. Kazan (XI century), Nizhny Novgorod (XIII century), Samara (XVI century), Voronezh (XVI century). They all developed around the same time, but during the Soviet period they were characterized by the following events:
- a new industry came to the country in wartime;
- the growth of cities has gone beyond the territories of enterprises, thus leaving them within the city in the future;
- the historic factories in the city center have fallen into disrepair due to dilapidation.

The study concerns the urban planning situation and identifying businesses that are not working or are in decline and already have significance in the city and have formed their habitat.

These analyses (Table 1, 2, 3, 4) generalize industrial buildings by type of industry and by location in the city.

For a more in-depth study, 4 industrial enterprises were selected, one from each of the studied cities (Table 5, 6, 7, 8). These objects were chosen because of their impact on the urban environment and the prospects for their renewal.

Table 1. Kazan. Analysis of existing and inactive enterprises in the city.

| Type of industry                | Existing enterprises | Inactive enterprises | Location                                                                 |
|--------------------------------|----------------------|----------------------|--------------------------------------------------------------------------|
| Home construction              | ZHBI-3 (1947), DSK   | ZHBI-2               | The industrial zone is located along the railway line that runs through the city center |
| Chemical industry              | Arakchinsky gypsum (1947), Kazan synthetic rubber plant (1931), Kazan gunpowder plant (1788), Kazanorgsintez (1963), Kazan silicate materials plant (1930) | -                     | Enterprises are located along water areas and along the railway line |
| Mechanical engineering industry| Kazan Aircraft Production Association (KAPO) (1932), Kazan Helicopter plant (1940), computers plant (EVM) (1951) | Helicopter factory workshops (partially) (1940) | The enterprises are located in the central part of the city and form several industrial hubs |
| Instrument industry            | Elekon (1939), KOMZ (1940), Kazancompressormash (1951), camz (1957), KZGA, Kazanorgsintez | Kazan photogelatin factory (1935), Santekhpribor (1947) | Enterprises are spread across the city |
(1963), Volzhanin (2007), Kazan crane plant "Gertek" (2012).

| Light industry | Felt factory (1932) | Alafuzov's flax-spinning factory (1865), Spartak Shoe factory (1916), Sewing Association «Kiemner» | Enterprises are spread across the city and located along water areas |
|---------------|---------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Food industry | Kazan distillery (1975), Bakery and confectionery plant (1986), Kazan bakery No. 3 (1939) | Petzold brewery (1898), Elevator, Vinegar factory on Gladilova street | Enterprises are located along water areas and along the railway line |

Table 2. Nizhny Novgorod. Analysis of existing and inactive enterprises in the city.

| Type of industry               | Existing enterprises | Inactive enterprises | Location |
|-------------------------------|----------------------|----------------------|----------|
| Home construction             | 78 DOC-NM            | -                    | Enterprises are concentrated in one industrial hub on the outskirts of the city |
| Chemical industry             | Polyterm, Salyut-NN, Nizhp Pharm | Nizhny Novgorod oil and gas plant | Enterprises are concentrated in industrial hubs in the city center |
| Mechanical engineering industry | GAZ, ALGOL, Nizhny Novgorod plant of the 70th anniversary of Victory, Oktyabrsky shipbuilding plant, Prioksky mechanical plant, Volga Shipbuilding plant, «Chaika-Service» Automobile plant | Etna plant, Krasnaya Ramen chain plant, Machine tool plant, Car repair plant, Bicycle Factory, GAZ foundry | Enterprises are dispersed throughout the city and form industrial hubs |
| Instrument industry           | Incom, Metal, Gorky plant of communication equipment named after A. S. Popov | Nizhny Novgorod plant of testing and technological equipment (1969), Gorky plant of milling | Enterprises are located along water areas and along the railway line |
| Type of industry                | Existing enterprises                                                                 | Inactive enterprises                                                                 | Location                                                                                       |
|---------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Light industry                  | «Nizhegorodmebel and K» Nizhny Novgorod clothing factory Mayak (1914)                 | Enterprises are located in the peripheral part of the city                              |                                                                                               |
| Food industry                   | Sormovskaya confectionery factory, Nizhny Novgorod dairy plant No. 1(1964)           | Flour mill, Elevator, Bakery warehouse, Mill, Confectionery factory May 1 (1894)        | Enterprises are dispersed throughout the city                                                   |
| Table 3. Samara. Analysis of existing and inactive enterprises in the city. |                                                                                      |                                                                                       |                                                                                               |
| Type of industry                | Existing enterprises                                                                 | Inactive enterprises                                                                 | Location                                                                                       |
| Pulp and paper industry         | Printing house «Samarablankizdat» (1918), Samara house of printing (1963)            | Enterprises are dispersed throughout the city                                          |                                                                                               |
| Chemical industry               | Betolite, Kuibyshev oil refinery(1943)                                              | Silicate plant (1929)                                                                  | Enterprises are concentrated in one industrial hub on the outskirts of the city                 |
| Mechanical engineering industry | Aviakor (1941), Srednevolzhsky Machine-Building Plant (1926)                         | -                                                                                     | Enterprises are located along water areas and along the railway line                           |
| Instrument industry             | KVOiT (1970), Metallurg (1951), Energoshit (1943), Samara metallurgical plant (1951), Samara Electromechanical plant (1941), Samara bearing plant-4, Samara transformer (1944), Srednevolzhsky machine-tool plant (1876) | Plant Maslennikova (1909), Repair and mechanical combine, Samara plant klanpanovat (begining XX century), Kuibyshev plant of coordinate boring machines, «Samara Tool Plant» (1934) | Enterprises are dispersed throughout the city, especially large ones form an industrial hub |
| Light industry                  | Samara combine of ceramic materials (1912)                                          | -                                                                                     | Enterprises are located on the outskirts of the city along the water territories               |
### Table 4. Voronezh. Analysis of existing and inactive enterprises in the city.

| Type of industry         | Existing enterprises                                                                 | Inactive enterprises                  | Location                                                                 |
|--------------------------|--------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------------------|
| Home construction        | Voronezh plant of construction materials (1954)                                      | Voronezh ZHBI-4 (1943)                | Enterprises are located on the periphery of the city along the water territories and forms an industrial hub |
| Pulp and paper industry  | -                                                                                    | Printing shop «Commune» (1917)        | Enterprise is located in the city center                                  |
| Chemical industry        | Voronezh chemical and pharmaceutical plant (1934)                                   | -                                     | Enterprise is located in the city center                                  |
| Mechanical engineering industry | Voronezh car repair plant (1912), Voronezh joint-stock aircraft building company (1932), Avtolitmach (1999), 172 Central automobile repair plant (1945), Voronezh joint-stock aircraft building company (1932), Voronezh mechanical plant (1928) | Voronezh excavator plant (1915), Processor Plant (1970) | The industrial zone is located along the railway line that runs through the city center |
| Instrument industry      | Voronezh machine-tool plant (1960), Electroprivbor (1956)                           | Voronezh plant of radio components (1950), Voronezh aluminum plant (VAIIZ) (1973) | The industrial zone is mainly located along the railway line that runs through the city center |
| Light industry           | Voronezh ceramics (1954), Voronezh knitwear manufactory (1939)                       | Voronezh glass container plant Rasko  | The industrial zone is located along the railway line that runs through the city center |
| Food industry            | Voronezh experimental feed mill                                                     | Distillery                            | The industrial zone is located along the railway line that runs through the city center |
(1936), Voronezh confectionery (1900) factory (1934), Voronezh brewery (1936) zone is located along the railway line that runs through the city center

Table 5. Kazan. The building analysis.

| Name               | Pitzold brewery                                      |
|--------------------|------------------------------------------------------|
| Photofixation      |                                                     |
| Year of construction | 1898                                                |
| Location           |                                                     |
| Area               | 14 000 m²                                            |
| A typology of enterprises | Food industry                                      |
| Status             | In the process of discussing renovation              |
| Style              | Modern                                               |
Table 6. Nizhny Novgorod. The building analysis.

| Name                  | Mayak clothing factory |
|-----------------------|------------------------|
| **Photofixation**     |                        |
| **Year of construction** | 1914                  |
| **Location**          |                        |
| **Area**              | 4 000 m²               |
| **A typology of enterprises** | Light industry       |
| **Status**            | In the process of discussing renovation |
| **Style**             | Modern                 |
**Table 7.** Samara. The building analysis.

| Name                  | Printing house               |
|-----------------------|------------------------------|
| Photofixation         |                              |
| Year of construction  | 1963                         |
| Location              |                              |
| Area                  | 24 000 м²                    |
| A typology of enterprises | Pulp and paper industry |
| Status                | The building is abandoned    |
| Style                 | Constructivism               |
Table 7. Voronezh. The building analysis.

| Name              | Electropribor  |
|-------------------|----------------|
| **Photofixation** |                |
| **Year of construction** | 1956          |
| **Location**      |                |
| **Area**          | 29 000 m²      |
| A typology of enterprises | Instrument industry |
| Status            | The company is in decline |
| Style             | Constructivism |
3 Results
In the course of two analyses, we obtained the following conclusions. In the first analysis (Table 1-4) on the search in historical cities of Russia, we identified the following patterns of location in the city:

1. Housing construction enterprises are located along the railway line that passes through the city center (Kazan), and are concentrated in one industrial hub on the outskirts of the city (Nizhny Novgorod, Voronezh).

2. Chemical industry enterprises are located along water areas and along the railway line (Kazan), are concentrated in industrial hubs in the city center (Nizhny Novgorod), are concentrated in one industrial hub on the outskirts of the city (Samara), are located in the city center (Voronezh).

3. Machine-building enterprises are dispersed throughout the city and form several industrial hubs (Kazan, Nizhny Novgorod), located along water territories and along the railway line (Samara, Voronezh).

4. Instrument-making enterprises are dispersed throughout the city (Kazan, Samara), located along water areas and along the railway line that runs near the city center (Nizhny Novgorod, Voronezh).

5. Light industry enterprises are dispersed throughout the city and are located along water areas (Kazan, Nizhny Novgorod, Samara), along the railway line that runs through the city center (Voronezh).

6. Food industry enterprises are located along the water territories and along the railway line (Kazan, Samara, Voronezh), and are dispersed throughout the city (Nizhny Novgorod).

Historically, industrial enterprises were built on the main transport routes (railway or water), where it is convenient to import raw materials or export products.

For the second analysis (Table 5, 6, 7, 8), 4 objects of different types of industry were selected, namely:

1. Pitzold brewery, Kazan, built in 1898. Food industry
2. Mayak clothing factory, Nizhny Novgorod, built in 1914. Light industry
3. Printing house, Samara, built in 1963. Pulp and paper industry
4. Electropribor, Voronezh, built in 1956. The industry of instrumentation.

In the comparative analysis, the following features were identified, summarizing them:

1. Location in the central part of the city;
2. Extended planning structure that is typical for industrial buildings;
3. An expressive appearance that identifies a given area with a specific building;
4. Their location is linked to the area, and further liquidation of these enterprises will tear the urban fabric.

On the basis of literary, nature and comparative analyses, the following directions of identity principles were identified in the renovation of industrial facilities:

1. Urban planning direction:
   - The basis of the architectural composition of the city is the architectural and spatial order of the city, which determines its visual and artistic integrity. The architectural composition of the city plan is also largely expressed by the street and road network, its framework in the form of main directions and nodes. The road network is perhaps the most visual expression of the composition of the urban plan, because in the nature of its faces it directly or indirectly reflects more than just transport basis for the compositional structure of the city – natural landscape, historical-genetic, functional, and architectural art and engineering technology.
   - The possibility of point change (urban acupuncture) – a small-scale intervention in the urban fabric that can enliven the urban space;

2. Spatial planning direction:
   - The volume and spatial compositions of enterprises determined by technology, the nature of the surrounding buildings and transport infrastructure are typologically differentiated by industry. That is why they are all peculiar and unique in nature.
   - The need to preserve the structure (for those buildings where you need to leave the structure in its original form when adding a new function);
3. Stylistic direction:
- Preservation of historicity (preservation of facades and interiors in the original style without introducing foreign objects);
- Integration techniques (use of new materials in the external appearance of the building, as well as in the internal environment (interior));
- Possibility of radical changes (changing the appearance of the building by replacing it with a modern new style).

4 Discussion
Currently, there is a review of industrial enterprises, their significance in the city. The recent second Russian youth architecture Biennale also confirmed the significance and relevance of the renovation, where many projects were presented for two important territories of Kazan.

However, the fate of objects that have undergone renovation is not always solved successfully enough. It is already possible to judge how renovation objects have been introduced into the urban environment. The problem of local identity is not often solved successfully. For example, in an attempt to renovate the Alafuzov factory (Kazan), there was a junction of two main directions: the spirit of the place of the original territory and a new youth function, which is very specific superimposed on the original building. So far, the factory stands apart from the city and does not fit into the environment organically. As a result, the factory is looking for a new value in the city. There is no universal recipe for the development of industrial zones: each site must be analyzed individually.

Sometimes it is impossible to restore a building, most often because of structures that will not be able to withstand further operation, and repairs are expensive. Then demolition is also a renovation to which the principles of identity apply. In this case, it is important to preserve the current urban planning situation and, if possible, leave the responses of the previous object in the future. As, for example, during the renovation of the embankment of Nizhny Novgorod the elevator was demolished, which is an important dominant. Initially, it was planned to remain it, but the survey showed that this is not possible. In its place, a tall building will also appear which will support the existing situation and will not break the city fabric.

Separately, you can make a point of protecting cultural monuments, which may include some abandoned businesses. The principles described above apply to buildings that do not have the status of objects of Cultural Heritage, but have a strong urban significance and can not be ignored during the renovation process.

This research is of practical significance, since the principles of identity are applicable to all industrial territories. Renovation has a great potential, because in Russia there are a large number of inactive enterprises and those that are in decline. In our research, we are looking for directions that will help to identify and preserve the uniqueness of the area, beating the multicomponent spatial environment.

5 Conclusion
The study solves the problem, which was to identify the principles of identity of former industrial territories to the new conditions of the urban environment, while improving their quality. The experience of renovation of industrial zones in Russia is not yet sufficiently developed and is only gaining momentum. If you do not pay special attention to preserving the identity of the place, then the city itself will lose its uniqueness.

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