Redevelopment of Ex-industrial Areas in Yekaterinburg

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Abstract. Improving the comfort of the urban environment is a key goal of its development. Redevelopment can be used as a way to achieve it. The authors studied the historical perspective of the creation of the Ural cities, as well as the experience of implementing redevelopment projects of industrial areas in the city of Yekaterinburg. It was proven that the largest share of such projects was implemented through the complete demolition of Soviet-era buildings that had no architectural and historical value. The authors used general scientific research methods, such as analysis and synthesis, comparison and generalization, as well as methods of induction and deduction.

1. Introduction
Creating a high-quality urban environment is a strategically important task for any modern city. However, most large cities do not have enough land plots for the construction of new significant objects for the urban community within the city limits. A national project "Housing and Urban Environment" has been created in the Russian Federation [1]. It is aimed to improve the comfort of the urban environment and to create a mechanism for the citizens’ direct participation in its formation. The relevance of this study lies in the following: the necessity of researching architectural and urban planning heritage of the Ural mining settlements; the quantitative analysis of the industrial areas of the city of Yekaterinburg in need of redevelopment; the identification and assessment of features and trends of the implementation of such projects (complete demolition and construction of new facilities or reconstruction and adaptation of existing buildings and structures with a change in their functional purpose); the cumulative assessment of the impact of redevelopment projects on the modern look of the city.

2. Materials and methods

2.1. The concept of “redevelopment”
The authors studied several publications dedicated to the redevelopment of obsolete industrial facilities. The implementation of such projects in the framework of redevelopment is covered from different angles, however, there is no common understanding of the stages, tasks and objectives of this process, as well as methods for assessing the effectiveness of redevelopment projects.

The concept of "redevelopment" appeared in 1945 in the United States. In the California Community Redevelopment Law, it was defined as follows: ““Redevelopment” means the planning, development, replanning, redesign, clearance, reconstruction, or rehabilitation, or any combination of
these, of all or part of a survey area, and the provision of those residential, commercial, industrial, public, or other structures or spaces as may be appropriate or necessary in the interest of the general welfare" [2].

In Russia, this concept appeared in the 1990s, but it has not yet been defined at the legislative level. It is also described in different ways by different authors. In the works of E.I. Tarasevich, "redevelopment involves clearing a plot of land from existing structures and erecting a new building or structure" [3]. V.I. Malakhov proposes to define redevelopment as an entrepreneurial activity in the field of development, which is associated with the change of existing real estate objects in order to achieve entrepreneurial goals by increasing their value [4]. According to E.A. Karaulanova, redevelopment is "a process of secondary, usually integrated development of individual real estate objects, a group of buildings or territories. This is their re-profiling into completely new objects, often with a change in their functional purpose, in order to use them most efficiently" [5]. D.K. Polyakov and S.V. Pupentsova define redevelopment as "the process of reconstruction of real estate objects not in use in their current state, or revitalization of inefficiently used territories with a change in their functional purpose" [6]. In addition to the concept of "redevelopment", the concepts of "renovation", "revitalization" and "gentrification" are used, which are similar in meaning [7, 8]. Most authors point out that redevelopment should result in positive financial, social and environmental effects from the implementation of a development project in a specific territory [9, 10]. I.V. Smirnova examined the forms of redevelopment projects and proposed to consider two main directions of redevelopment - the reconstruction of buildings and the redevelopment of territories [11].

2.2. Prerequisites for the redevelopment of industrial areas
In the context of modern global trends in the megacity development, industrial areas with obsolete and economically unprofitable facilities, especially in the city center, create problems with logistics and ecology and are becoming an obstacle to ensuring the process of sustainable development. As cities enter the post-industrial era, they start searching for new ways to improve urban infrastructure, which leads to redevelopment of these territories [9].

The positive side of redevelopment is, undoubtedly, the fact that developers obtain land plots in the central part of the city in conditions of a general land shortage. The plots are usually provided with a basic power system, road and transport infrastructure, proximity to developed public and residential areas. However, the redevelopment of industrial areas is much more difficult than the development of undeveloped territories. In redevelopment, the choice between the demolition of existing buildings and their reconstruction is always relevant. Another important aspect is the need to change the type of permitted use of the land plot (change of industrial land into public and business areas or into land for residential development) [12, 13]. This is a complicated process: it takes a lot of time and consists of several stages, including public hearings and the approval of the City Duma. Industrial areas are often polluted, so they require ecological regeneration of the environment in order to restore the natural framework, and the existing engineering and transport infrastructure often require reconstruction [14]. However, the implementation of redevelopment projects increases the value of these land plots [15] and allows the interested parties to get a positive effect from investing capital in such projects [16].

2.3. Historical perspective of the creation of the Ural cities
Cities and settlements of the Middle Urals are usually called "city-plants" and "mining settlements" due to their history. The founding periods of these cities date back to the 18th – 19th centuries, when large reserves of iron and copper ore were discovered in the Urals and these deposits began to be developed. The metal smelting plant was the origin of the Ural cities, with management, spiritual life, education and trade arising around it. Most of these cities were geographically tied to deep rivers on which the dams were built. They were used in the production process as the energy source. The dam and the plant were the central point that formed the elements of the settlement system and provided the basis for the future cultural landscape of the city. The low Ural Mountains made it possible to build
roads, including the Ural Mining Railway, which connected the cities. It had a significant impact on the development of the economy [17, 18, 19].

The Ural capital - the city of Yekaterinburg – was founded as a fortress factory in 1723. It has a similar layout, since it was historically formed as a typical Ural city. The dam on the Iset River and the iron-making plant were the center of the city. The city quickly became a large industrial center of the country. From 1924 to 1991, the city of Yekaterinburg was called Sverdlovsk, where the world's largest metallurgical and machine-building plants Uralmash, Uraltransmash, Uralkhimmash successfully operated. During the World War II, factories from the European part of the country were evacuated to the region, filling the city with vast industrial areas. Whole urban areas that still exist today (Uralmash, Elmash, Khimmash) were built for the plants’ workers. The urban planning structure, architectural solutions and people's lifestyle were subject to the interests of metallurgical production and heavy industry. In 1967, industrial Yekaterinburg, which was closed to foreigners, became a million-plus city. The economic reforms carried out in Russia in the early 1990s have made significant changes in the foundations of the city’s economic structure and greatly influenced the development of spheres which were not significant in the urban economy up to that point: retail and service, communications, information technology, tourism. In 2001, Yekaterinburg became the administrative center of the Ural Federal District. The development of trade, small and medium-sized businesses and tourism has reached a qualitatively new level. Shopping centers, cultural and public facilities began to appear. The population grew by 21.5% and amounted to more than 1.5 million people in 2020 [20].

3. Results and discussion
In Yekaterinburg, redevelopment projects have been implemented since Soviet times. A good example of this is the Museum and Memorial Complex "Historical Square", which was created in 1973 for the 250th anniversary of Yekaterinburg. It is located on both sides of the Iset River. The central point is "Plotinka" - a former iron-making plant, around which the city-plant was built. There is also the memorial zone with the preserved appearance of the plant, which houses the Museum of the History of Architecture, the Museum of Nature and the Water Tower. This complex has become the historical center of the city, which is currently the center of attraction for citizens and guests of the city.

At the beginning of 2018, adjustments were made to Yekaterinburg’s development plan [21], which included the development of previously built-up areas. The total area of Yekaterinburg is 114 thousand hectares, 49% of which is the urbanized area. At the same time, 23% of the city area, mainly in the center, is occupied by industrial facilities [22], which creates serious obstacles to the sustainable development of a modern city. By 2025, 133 industrial facilities with a total area of almost 250 hectares are to be transferred from Yekaterinburg to remote areas.

Industrial enterprises that vacate sites in the city center with good infrastructure usually move to specially created industrial parks located outside the city. Table 1 presents several examples of ongoing redevelopment projects of industrial areas in the city of Yekaterinburg over the past 15 years. It is expected that the number of such projects will increase over time, since there are a lot of obsolete industrial areas in the city.
Table 1. Redevelopment projects of industrial areas in Yekaterinburg from 2005 to the present.

| Industrial facilities                              | Redevelopment project          | Project parameters                                      | Property type                                      |
|---------------------------------------------------|--------------------------------|-------------------------------------------------------|---------------------------------------------------|
| Ural Bearing Plant, built in 1941                  | Residential complex "Bazhovsky"| Land area - 8.3 ha<br>Area of real estate objects - 170 thousand sq. m. | Residential with commercial space on the ground floors |
| Factory “Uralobuv”, built in 1934                   | Residential district "Universi-tetsky" | Land area - 13.7 ha<br>Area of real estate objects – 480 thousand sq. m. | Residential with commercial space on the ground floors |
| “Uraltrans-mash” plant, built in 1970s              | Residential complex "Ekaterininsky Park" | Land area - 30 ha<br>Area of real estate objects – 300 thousand sq. m. | Residential with commercial space on the ground floors, offices, hotel, shopping center |
| Yekaterinburg non-ferrous metal processing plant, built in 1950s | Residential complex of premium class "Lenina 8" | Land area - ... | Residential with commercial space on the ground floors, offices, hotel, shopping center |
Land area - 1.85 ha
Area of real estate objects – 43.9 thousand sq. m.
Residential with commercial space on the ground floors, fitness center, restaurants, shops

Plant "Uralplastic", built in 1941

Residential complex "Stolychnye Kvartaly"

Land area - 25 ha
Residential area 300 thousand sq. m., school for 1050 people, 2 kindergartens for 550 children, multilevel parking for 3 thousand cars.
Residential, school, 2 kindergartens, multilevel parking

Plant of reinforced concrete products "Betfor", built in 1957

Residential complex "Rassvetny"

Land area - 9 ha
Area of real estate objects – 180 thousand sq. m.
Residential with commercial space on the ground floors

"Avtokolonna 1212", built in 1942

Residential complex "Malevich"
Land area - 2,9 ha
Area of real estate objects - 15 thousand sq. m.
Residential with commercial space on the ground floors

Vorovsky Drilling Equipment Plant, built in 1929
Residential complex "Parkovy Kvartal"

Land area - 6,6 ha
Area of real estate objects – 147,4 thousand sq. m.
Residential with commercial space on the ground floors

“Uralkabel” plant, built in 1954
Residential complex "Nagorny"

Land area - 2,48 ha
Area of real estate objects - 60 thousand sq. m.
Residential with commercial space on the ground floors

Factory "Ural Jewelers", built in 1970s
Residential complex "Novaya Botanika"

Land area - 2 ha
Area of real estate objects – 52,4 thousand sq. m.
Residential with commercial space on the ground floors

Factory "Kauchuk", built in 1960e
Residential complex "Uktus"
Musical Instrument Factory, founded in 1928  
Land area - 20 ha  
Area of real estate objects – 215 thousand sq. m.  
Residential with commercial space on the ground floors

Business center "Kvartal"  
Land area - 13 ha  
Area of real estate objects - 33.5 thousand sq. m.  
Business center of "B" class

Civil Aviation Plant, built in 1939  
Land area - 19.9 ha  
Bus station area - 308 thousand sq. m., incl. commercial 147 thousand sq. m.  
Multilevel parking for 5.6 thousand cars  
Trade and transport interchange hub, with commercial space, multilevel parking

Bus station (coach terminal)  
Ural Instrument Making Plant, built in 1918  
Cathedral of the Holy Great Martyr Catherine  
Land area - 1.52 ha  
Area of real estate objects – 10.5 thousand sq. m.  
Religious purposes

Redevelopment type - Facades are being reconstructed. New development

Cultural heritage site of the Russian Federation, Simonov-Makarov Mill, built in 1884  
Residential complex "Makarovsky"
Most of these projects were carried out through complete demolition, site clearing and new construction, and not by adapting existing buildings for new purposes. Table 2 shows the indicators of these projects. Most of the projects are residential developments with commercial space on the ground floors, which allows the developer to maximize profit.

Table 2. Analysis of redevelopment projects of industrial areas in Yekaterinburg.

| Indicators                                    | Number of projects under consideration | Land area, ha | Share, % | Area of new real estate objects, thousand sq. m | Share, % |
|-----------------------------------------------|----------------------------------------|---------------|----------|-----------------------------------------------|----------|
| Total projects                                | 16                                     | 162,5         | 100      | 2464,5                                       | 100      |
| Incl. redevelopment projects implemented by  |                                        |               |          |                                               |          |
| - demolition and new construction             | 14                                     | 156,25        | 96,15    | 2315,7                                       | 94       |
| - reconstruction and re-profiling            | 2                                      | 6,2           | 3,85     | 148,8                                        | 6        |
| Housing construction projects                 | 13                                     | 128,08        | 78,8     | 2112,5                                       | 85       |
| Projects developing transport infrastructure  | 1                                      | 19,9          | 12,2     | 308                                           | 12,5     |
| Projects developing the cultural value of the city | 1                                      | 1,52          | 0,93     | 10,5                                          | 0,42     |

The redevelopment of the Civil Aviation Plant is a distinct project that develops the city's transport infrastructure. A new bus station will be built instead of the plant by 2023, the year of the Universiade and the celebration of the 300th anniversary of Yekaterinburg. There will also be the largest Russian
transport hub with a shopping center connected to the Botanicheskaya metro station. The project will include two ground multi-level intercept parking lots for 5.6 thousand cars. The total area of the complex, including the new bus station, will be 308 thousand square meters. The retail area will amount to 147 thousand square meters [23].

The redevelopment of the "Ural Instrument-Making Plant" and the construction of the Cathedral of the Holy Great Martyr Catherine on its territory is a unique project. Previously, there were attempts to restore the cathedral at other sites in the city, but all those projects failed due to public protests. In 2010, there was an option to construct the cathedral in the Labor Square; the fountain and green spaces were supposed to be demolished. In 2016, it was proposed to place the cathedral in the city pond water area, in 2019 – in one of the squares in the very center of the city. The active civic involvement of the Yekaterinburg residents (via citizens vote) led to the final decision to choose the site of the Ural Instrument-Making Plant for this purpose. This project will revitalize decayed objects by giving meaning and improving comfort of the environment and create a modern multidirectional point of attraction located in the historical place of the city's origin. Also, it will meet the requirements of different local communities: Diocese, leaders and specialists of regional and municipal government, business community, public organizations, Orthodox parishioners and city residents.

Only two projects from the list implemented redevelopment by reconstruction and re-profiling, and not through a complete demolition and cleaning of the site: redevelopment of cultural heritage objects "Borchaninov-Pervushin Mill" built in 1908 (residential complex "Melnitsa") and "Simanov-Makarov mill (Ivanovskaya steam roller mill)" built in 1884 (residential complex "Makovsky"). The implementation of the project of the residential complex "Melnitsa" not only allowed developers to extract the maximum profit, but also realized the idea of integrity through a compromise between "modernity" and "history". The object’s facade is a historically dominant building element of one of the main city roads and an element forming the urban planning ensemble of the square of the Yekaterinburg railway station. The project of the residential complex "Makovsky" involves the construction of a multifunctional residential complex of "business" and "elite" class, as well as the redevelopment of two buildings recognized as architectural monuments by restoring their facades to maintain the architectural appearance of the 1910s. They will house a restaurant and a library.

These two projects are certainly much more difficult to implement, but they solve important problems for the city – they create real estate objects by meeting the needs of modern society and eliminating obsolete industrial facilities. At the same time, they preserve the historical and architectural heritage of the city, maintain its uniqueness and originality, keep it distinct and recognizable, as well as improve its attractiveness for residents, tourists and future generations.

4. Conclusions
To explore redevelopment as a tool for replacing ineffectively used industrial objects in Yekaterinburg with modern facilities that develop urban environment, the authors accomplished the following: studied the works on this topic; investigated the prerequisites for the implementation of redevelopment projects of industrial areas with regard to the historical perspective of the emergence of Yekaterinburg as a typical Ural city; analyzed redevelopment projects in Yekaterinburg from 2005 to the present. The authors came to the following conclusions:

- The city of Yekaterinburg, founded as a city-plant, has a huge obsolete industrial fund. It needs to redevelop 133 industrial facilities with a total area of 250 hectares, which must be relocated to remote areas by 2025.
- This study presented and analyzed 16 redevelopment projects of industrial areas in Yekaterinburg from 2005 to the present, with a total area of land plots of 162.5 hectares and an area of new real estate objects of 2464.5 thousand square meters.
- The redevelopment project of a bus station, which creates a modern transport interchange hub and develops the transport infrastructure of the city, takes 12.2% of the ongoing industrial redevelopment projects (19.9 ha). It will improve the quality of the urban environment not only by upgrading transport accessibility and connecting the entire urban and suburban space,
but also by reducing the structural and planning contradictions between transport and the urban environment.

- The redevelopment project of 1.5 hectares of industrial territories (construction of the Cathedral of the Holy Great Martyr Catherine) does not bring commercial benefits to the developer. However, it brings aesthetic, cultural, educational and spiritual value to the city. There are many examples of new cultural and religious objects becoming significant symbols and brands of the territory.

- A distinct feature of most redevelopment projects in the city of Yekaterinburg is the complete demolition of obsolete facilities and the construction of new ones (14 out of 16 projects, which is 96% of the studied areas). Housing construction projects take up the largest share - 78.8%, with a total area of 128 hectares. Only two projects are redeveloped by reconstructing facades (6.2% of projects), and this is only due to the fact that both of them include objects of the cultural heritage of the Russian Federation which cannot be demolished. On the one hand, this method of territory renewal does not preserve the existing historical and architectural heritage of Yekaterinburg. On the other hand, the city’s industrial facilities did not have any historical or architectural value as ordinary industrial hangar workshops built in Soviet times. In order to maintain the uniqueness of Yekaterinburg, it is necessary to find the balance between the preservation of "historical" objects and the creation of a comfortable urban environment for thoughtful development and renewal.

The idea of integrity provides the understanding that modern and historical objects interact with each other and influence each other. Hence, redevelopment projects of industrial areas may be aimed at activating or changing the quality of multi-level relations between its subjects, with the inclusion of individual objects and complexes of historical and architectural heritage in these relations [17, 19]. It is important to understand that distinct features of architecture and lifestyle must not only be maintained, but also adapted to the current needs of the residents and regarded as the future heritage for the next generation.

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