Alternative Scenarios for Sustainable Redevelopment of Soviet Industrial Brownfields in Russia

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Abstract. The role of redevelopment of former industrial territories considered in connection with the tasks of environmental and social improvement of Russian megacities. Theoretical bases and practice of industrial areas reorganization in the world and in Russia analyzed. Urban planning features and economic restrictions determine the different ordering of the former industrial territories and the degree of development their functional and spatial relationships. Therefore, there are various opportunities for their new diversified use. Examples based on regional and local characteristics shown. A systematize attempt to the main directions of the reorganization approaches was made. Three directions that correspond to the goals of sustainable development and improving the quality of life highlighted. They received the conventional names "oasis", "service" and "buffer". Their brief characteristics are given.

1. Introduction

In the Russian Federation, the basis of economic potential is industrial enterprises and research and production complexes. They are concentrated in historical and new cities. The rapid development of industry in the period of formation of the domestic economy in the end 19th – mid. 20th century was the reason for the formation of a significant number of mix-used territories. There, factory, communal and residential facilities were located side by side.

In the soviet theory of urban planning, as well as in the rules of planning and development, the principles of territorial distancing of industrial and residential zones for a long time dominated. This approach was unacceptable in relation to historically developed cities, where industrial enterprises of the former suburbs were gradually involved in the structure of the city. The situation has changed with the entry of society into the post-industrial stage of development. It became clear that in order to improve the quality of life, not only urban planning, but also economic policy should change. During the socio-economic reforms at the late 1990s – early 2000s numerous resource-intensive plants and factories closed in many cities of Russia.

Analysis of the experience of development of these territories shows that to date, the Russian urban planning science has not formed a national comprehensive strategy and tactics for their redevelopment. Meanwhile, the situation is getting worse every year. It is obvious that the former production areas need to be use special conversion methods. They should help to remove contradictions between environmental and social factors, increase the quality of life of citizens and improve the properties of the urban environment.
2. Materials and methods

The most important issues of including depressive production facilities in the active life of cities were considered in the scientific works of H. Rafson and R. Rafson – 1999 [1], K. Gotem – 2001 [2], D. Adams and C. Watkins – 2002 [3], J. Hollander, N. Kirkwood and J. Gold – 2010 [4], C. Behrens – 2011 [5] and P. Mercaer-Moyano – 2017 [6].

In Russia, the theoretical prerequisites for creating a multi-factor methodology for redeveloping industrial brownfields and ensuring their sustainable development are studies in environmental problems of different urbanized territories (O. Yanitsky – 1987, V. Vladimirov – 1982, S. Generalova – 1982, V. Krasilnikov – 1992, S. Mityagin – 2016, S. Chistyakova – 1988, etc.) and in assessment and management methods of urban planning systems (E. Akhmedova – 1994, G. Azgaldov – 1989, Yu. Bocharov – 1987, S. Kabakova – 1981, etc.). Some scientists paid attention to particular aspects of pre-project assessment of natural, urban, social, environmental and economic factors, justification and use of techniques to reduce the negative impact of industrial enterprises and brownfield redevelopment (A. Golovin – 1981, V. Samogorov – 1986, E. Morozova – 1987, T. Vavilova – 1997, A. Yakovlev – 2000, S. Bachurina – 2005, S. Maximov – 2005, N. Sinitsyna – 2005, S. Frolov – 2005, V. Aleksashina – 2006, A. Golub – 2006, A. Bezrukov – 2007, P. Varaksin – 2007, L. Plotnikova – 2008, E. Sokolova – 2008, D. Khrustalev – 2011, O. Silaeva – 2012, I. Yazhlev – 2012, A. Yakovlev – 2014, A. Raikin – 2016, N. Solonina – 2017, L. Titova – 2017, O. Telepneva – 2019, etc.).

The relevant practical experience of redevelopment of production sites in different countries, presented in electronic periodicals on architecture and urban planning, studied also. The main research criteria correlated with the goals and methods of sustainable development.

3. Results

3.1. Features of brownfield formation in the largest cities of Russia

The process of searching, developing and using urban planning rules for the mutual location of residential and industrial territories has been going on in Russia under the influence of intensive industrial construction in the middle and the late 19th century. In those years, strict regulations on the location of factories relative to residential areas of cities were absent. However, at the beginning of the 20th century, G. Dubelir, A. Ivanitsky, N. Markovnikov, V. Semenov, Z. Frenkel, etc. – the leading Russian urban planners raised the issue about the insufficiency of the old methods of managing the growth of cities through "highly approved" plans. They insisted on introducing a system of regulations governing urban development. The need to place industrial enterprises in special functional zones realized at the beginning of the twentieth century. It became an integral part of the Construction Charter (1908), soviet Rules for planning and building cities (1925, 1940), various construction rules and guidelines for planning and building urban and rural settlements (SNiP II-60-75** – 1975, SNiP 2.07.01-89 – 1989), the latest urban development regulations (SP 42.13330-2011, SP 42.13330-2016). The requirements for placing factories and factories in settlements according to the degree of danger of technologies were included into the stockpile of urban planning techniques in the 1930s – 1940s. In 1972, the parameters of exclusion zones formalized for the first time in the Sanitary standards for the design of industrial enterprises (SN 245-71). However, a number of circumstances did not allow us to make the distribution of sanitary protection zones universal and convenient. Primarily, this is due to the variety of urban planning features, as well as the historically close contact of industrial and residential zones. Since 1984, the Guide to the design of sanitary protection zones around industrial enterprises is used. There are three ways to reduce the size of exclusion zones: firstly, improving technologies; secondly, moving one of the functions (production or residential) outside the site; and thirdly, re-profiling enterprises.

In the 1990s, the inability to meet the necessary sanitary gaps and unprofitability became incentives to close businesses or move them to new sites. The stagnation of production has played an ambiguous role: on the one hand, social problems have increased, and on the other hand, the environmental situation
has significantly improved. The revitalization of soviet factory area is a necessary condition for the civilized entry of Russian cities into the stage of sustainable post-industrial development.

3.2. Review of modern Russian theory and practice of reorganization of former production territories

At the beginning of the 21st century in Russia, interest in the rational use of urban land increased. Therefore, in many cities, attempts made to redevelopment of the areas where soviet plants and factories are located. It is important that several international architectural competitions held to identify the transformation strategy of some sites (ZIL in Moscow, ZIM in Samara). To date, the most visible and completed projects are works in former industrial zones in Moscow and St. Petersburg.

Land exempted from industrial functions in Moscow considered as the main source for investment-attractive mass construction of housing and commercial real estate. Their total area in 2012 amounted to 4.3 thousand ha. Of these, 1.9 thousand hectares must be planning for housing, 1.1 thousand hectares must be converting into zones with various public buildings (trade, entertainment centers, offices, business centers, hotels) and 1.3 thousand hectares must be developing as natural recreational spaces. Reconstruction of dilapidated quarters recognized as economically inexpedient [19].

In the northern capital of Russia, from 2012 to 2016, the share of industrial territories involved in redevelopment almost doubled. In 2016, the industrial areas of the city that are subject to refunctionalization occupied about 5.8 thousand hectares in 12 administrative districts. The main directions of the revival of these sites are the construction of residential and commercial facilities [20]. Currently, more than 400 enterprises have been identified that need to optimize their functional and environmental solutions. Local architect A. Starygin proposed a multi-criteria matrix that helps to plan a flexible system of transformations [21].

In recent years, many proposals developed for regional centers in the Russian Federation. Let's consider at some of them.

The main goal of the conceptual project for the modernization of the Daldiesel plant in Khabarovsk is to create a multi-stage and multi-purpose complex. The concept developed recently. The authors proposed to build a new residential area on the site, place a children's research and rehabilitation center of orthopedic profile, and restore the production function on one of the sites in a new, innovative format. Improving the transport system and active landscaping can increase the attractiveness of the territory for residents and developers [22].

In Novosibirsk, the proposed renovation process extends to the mix-used zone, which is located in the Oktyabrsky district. Here, several large enterprises of metallurgy, mechanical engineering and food production continue to operate near residential and public facilities. Local scientists analyzed urban planning conditions, transport and pedestrian connections, as well as the environmental condition and compositional properties of the environment. It made it possible to develop recommendations for the conversion of facilities and the use of various renovation regimes in order to stimulate the service sectors of the economy [23].

In Samara, during the Soviet period, one of the largest production zones in Russia - Bezymyanskaya formed. The project focuses on several issues at once. Primarily it is the development of green areas near the river Samara and the reduction of anthropogenic load on the territory. In addition, the city's status as a center for science and innovation development upgraded. To do this, on one of the sites local architects propose to allocate an area for the creation of a world significance scientific and educational center. Until recently, the bearing plant was located on it [24].

Important generalizations made by Russian scientists who analyzed the system of depressive industrial facilities located within the Kazan agglomeration. The zones are adjacent to the aquatic area of the river Volga. The following principles of redevelopment proposed: integrity, structural-functional and territorial differentiation, environmental renovation, socio-economic efficiency, universal accessibility and openness. In the long-term development strategy, "growth points" outlined for each site. All of them include a set of basic residential functions. These are public recreational spaces, leisure facilities, trade, etc. [25].
The practice of redevelopment of industrial territories is becoming a typical phenomenon for many Russian megacities. The experience of implementing projects in Volgograd, Vladivostok, Yekaterinburg, Rostov-on-Don and other cities reflected in scientific publications of recent years.

3.3. Methods of rehabilitation of former industrial sites in the world urban planning practice

In the twenty-first century, brownfield redevelopment issues are receiving increased attention in a variety of countries. The first examples appeared during the economic recovery after World War II. Countries with high innovation potential have gradually begun to abandon the placement of manufacturing enterprises in major cities. In the 1970s and 1980s programs of rehabilitation of problematic industrial territories started in the largest historically formed cities in the UK, Italy, United States, China and other countries. They helped to improve the environmental and social quality of the environment. Now methods improve gradually.

In China, the need to eliminate depressed industrial areas followed by the gradual introduction of science-based practices. J. Yang used a combination of features to develop a system for assessing sustainability. Five priorities for brownfield’s redevelopment identified – increasing environmental conditions, improving urban planning and quality of settlements, economic development, improving social well-being and perfecting the protection of historical and cultural heritage. Their dominance or combination is different in the central, middle, or peripheral areas of the city. Therefore, recommendations for using brownfields cannot be universal [7].

Similar results obtained in the Czech Republic: the development prospects of brownfields located in different urban planning and transport conditions considered non-standard. In one of the works, the following regeneration options offered to residents: reconstruction, demolition, landscaping, and redevelopment. It turned out that demolition was preferred for sections inside the city, and reconstruction recommended for the center and suburbs [8]. In another study, according to the opinion of the population, brownfields that are not located on the outskirts of the city are most likely to experience a post-industrial revival. Peripheral objects perceived as new industrial loci where mass places of employment created [9].

The relationship between the intensity of use of industrial sites, their urban planning conditions and spatial parameters revealed in the collective work of American and Chinese scientists on the industrial zones of Shanghai. Land prices, distances to highways and major junctions, the level of economic development, the availability of existing and redundant industrial sites, and planning policies found to have a significant impact on changes in land use. The assumption about the relationship between transformation actions and industry factors made [10].

Canadian scientists S. Moser, G. Fauveaud, and A. Cutts saw the transformation of the manufacturing sector in Montreal as an incentive to promote economic and social transformation. They proposed to make the knowledge economy based on the development of education, science and art the basis of future economic growth [11].

Attention to the high cultural and historical value of brownfields emphasized in a significant number of works. In Mexico, the attitude of visitors to the gallery of modern art created in the building of a former textile factory studied. The history of founded and operation of the building, analysis of the transformation strategy and current state, as well as a survey of users allowed to establish an unambiguously positive result [12].

One of the most noticeable methods of ecological transformation of former production sites is their landscape transformation. In many countries of the world, the creation of parks and recreation areas is recognized as the most promising, as it contributes to improving the quality of life, allows you to improve the sanitary and hygienic quality of the environment and modify the infrastructure of public spaces. The results of the scientific works from Slovakia [13] and Korea [14], dedicated to the experience of Bratislava and Seoul, is the obviously demonstration.

Meanwhile, the way of brownfield’s redevelopment assessed differently by the designers, the public and realtors. A sociological study conducted in the Czech Republic revealed that the most attractive option for redevelopment for the population is the transformation of former industrial zones into
children's parks or cultural and sports facilities [15]. Different perspectives on evaluating the effectiveness of measures identify in Portugal. The main criteria for urban planners are the need and ability to prevent urban sprawl, but the most important way to improve the environment for the population are the development of open green areas and the creation of employment places. Economic, socio-cultural factors and the high cost of work are the most important aspects for realtors. These contradictions are currently the main obstacles to a removal of sites from a depressed state [16].

In the context of sustainable development, the issue of economical encouraging action remains one of the most important. In some countries (Germany, Great Britain, France, etc.), problems have been discussed and measures are being actively implemented since the beginning of the 21st century [17]. A group of scientists from Germany came to the paradoxical conclusion that redevelopment of brownfields is not a guarantee of increasing the sustainability of spatial development. Moreover, the contribution to sustainable development is not always associated with an increase in project implementation costs [18].

4. Discussion

Functional and spatial analysis of brownfields that have undergone redevelopment allows us to identify a number of typical alternative vectors of their urban planning reorganization. The study of many years of practical experience in the reorganization of former industrial territories in the world and in Russia allows us to identify three main urban planning models that meet the goals of sustainable development and improve the quality of life. In this study, they get the conventional names "oasis", "service" and "buffer". The purpose of implementing the "oasis" model is to restore the ecological and sanitary potential of the settlement. In this case, brownfields turn into forest parks, parks, boulevards, and recreational areas. Model "oasis" contributes to a comprehensive improvement of the bio-social and psycho-emotional conditions of life. The implementation of the model "service" based on the qualitative and quantitative transformation of sites. They are attractive for settlement of residents and cost-effective for potential developers. The location on highways and near public transport interchange points creates conditions for their more active saturation by service enterprises and increases the possibility of using this model. The "buffer" model is typical for situations when the need to develop new municipal or industrial facilities in a city detected, such as research and production complexes and technology parks, laboratories, information centers, etc. The former industrial territories of the middle and peripheral zones are a potential reserve for creating new employment opportunities in high-tech industries. The combination of problem situations allows to use combined types of models also: "buffer + service", "buffer + oasis", "service + oasis", "buffer + service + oasis". The decision on which model will be the basis for improving brownfields should be determined in the long-term socio-economic strategy for sustainable development of the city. It is likely that the type of model may change over time [26]. Assessing the quality of the urban environment and its degradation is the basis for choosing a specific combination. The results depend on its former purpose and intensity of operation. Now the solution to the problems of converting depressed factory sites of the soviet era integrated with the tasks of resource saving. Extending the life of buildings is the most important conditions for sustainable redevelopment. Currently insufficient attention paid to this issue in Russia.

5. Conclusions

It is obvious that the main tasks solved in the former industrial territories are to optimize the consumer qualities of the architectural and spatial environment. The study of theoretical and practical experience allows us to formulate the main principles for revival programs of these problem zones: a) integrated management based on the use of the entire "case" of methods (urban planning, legal, administrative, economic and organizational-technological); b) preservation and optimization of functional diversity (production, service, housing) in accordance with the location of the territory in the city; c) reducing anthropogenic pressure and increasing compensatory opportunities through the use of planning, landscape techniques and special methods of development and improvement; d) ensuring appropriate socio-cultural completeness to meet the needs of the population; e) compositional and aesthetic harmonization of the environment; f) historical continuity.
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