Creation of an information-integrated project management system for reprofiling of industrial facilities

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Abstract. There are renovation and conversion programs currently under way in all major Russian cities with million-plus population. Based on the findings of integrated survey of built-up areas, existing buildings and their architectural and space planning concepts, as well as the outdoor utility systems, and also taking into account economic expediency, developers make decisions on demolition of buildings or converting them into non-production facilities. Despite the available extensive international experience and a widespread similar trend everywhere in Russia, no system-based, research-backed approach to such projects is known to exist. The article discusses the basic principles of forming a system that permits the interconnection of project participants, organizational structures and information bases, leading to an increase in the effectiveness of the project’s main indicators, provides an opportunity for managers to quickly evaluate the activities of project participants and manage individual modules of the system. The main elements of the system are: conversion; information support, as well as organizational structure. The harmonious synthesis of these elements makes it possible not only to evaluate the existing level of efficiency, but also to design a system of interconnections, as well as to control it. The main basis for the formation of the possibility of designing this is the differentiation of the existing system and its elements into separate organizational and managerial modules. These modules allow to make their quantitative and qualitative assessment, which in turn, makes it possible to control the entire system.

Introduction
National and international historical experience of urban development shows that production territories have been generally located at the periphery of urbanized areas. This process has included the formation of production clusters that made it possible to structuralize logistics networks, to organize dynamic labor flows in rush hours and to ensure the development of interrelated production industries and services. However, in the course of urban development city outskirts tend to be absorbed by residential and administrative areas, while production facilities continue their operations providing jobs for such areas’ residents. As a result, after the lapse of several decades, industrial territories that used to be located far from residential and social areas are now actually in the central parts of megalopolises [5].

Materials and methods
This trend is characteristic of various European cities, for instance, London with its Docklands, the territory of former docks between the boroughs of Tower Hamlets and Newham on the left bank of the River Thames and Southwark and Greenwich on the right bank. The buildings of the docks located in
that area were part of the London port, one of the largest ports in the world. During the term of office of the British Government headed by Margaret Thatcher that worked out a regeneration program for this territory and in the subsequent years these buildings were redeveloped principally for commercial and residential use. Another prominent example of European industrial repurposing projects is the Musée d’Orsay in Paris. The museum facilities are situated in the former buildings of the same-name railway terminal. Of no less interest is the reprofiling project of Grugahalle warehouse complex in Germany, where the space planning solution made it possible to change its functional purpose and locate a cycling track and a family entertainment center inside it [4].

In the late 1990s the trend of reprofiling industrial facilities relocated outside the city limits reached Russia. The central parts of major Russian megalopolises became the site of numerous projects associated with completion of industrial cycles at production facilities and subsequent repurposing of these facilities. The principle causes of the abundance of such projects at the end of the last century included a number of factors.

Firstly, changes in the form of economic organization of the state at the beginning of the 1990s resulting in a drastic decline in the production level and, as a consequence, virtual wild-scale stoppage of production operations.

Secondly, the substantial wear of fixed assets that had received considerably less investment for upgrading since the mid-1980s. At the same time the primary trend shifted the balance between state budget financing and investment of the enterprises. As a result, in 1986 the centralized investment in the USSR economy as a whole declined threefold. According to the Federal State Statistics Service, in 1991 the volume of annual state budget investment went down by 15%, while production investment decreased by 24% with account of the price deflator.

Thirdly, the changes in the state policies and, accordingly, environmental and nature protection regulations predetermined additional non-operating expenditures in the form of penalty burden on enterprises that failed to conform to the new environmental requirements and standards.

Fourthly, as a consequence of the market economy development and formation of small- and medium-sized businesses in large cities, the income level of employees of such enterprises no longer matched the living standards of those employed in non-production sectors.

Fifthly, the changes in the assessment of the cadaster value of land leading to the tax rate being determined on the basis of its market value. For this reason, the cadaster value of municipal land grew by an average of 1.7 to 2.2 times since 2010. This increase in the cadaster value and the considerable resulting growth in the real estate tax burden meant for enterprises additional expenses of lease or taxes on the land, on which they were located (Table 1) [1].

**Table 1. Megalopolis Territorial Zoning Assessment**

| No. | City        | Percentage of the total city area | Green space areas, [m²/person] |
|-----|-------------|-----------------------------------|-------------------------------|
|     |             | Industrial zones | Green space areas | Water surface |                     |
| 1   | Vienne      | 12.8              | 21.0              | 8.0           | 25.0                |
| 2   | London      | 13.6              | 16.8              | 11.8          | 12.0                |
| 3   | Hamburg     | 12.8              | 22.0              | 11.8          | 14.9                |
| 4   | Paris       | 12.0              | 19.0              | 18.0          | 10.0                |
| 5   | Budapest    | 15.0              | 23.0              | 9.0           | 19.6                |
| 6   | Barcelona   | 18.0              | 17.0              | 5.0           | 21.0                |
| 7   | Moscow      | 16.0              | 22.0              | 4.2           | 18.1                |
| 8   | Saint Petersburg | 9.2           | 9.0               | 10.1          | 11.23               |
| 9   | Yekaterinburg | 16.1            | 19.0              | 2.6           | 14.1                |
| 10  | Samaraburg  | 19.8              | 14.8              | 8.8           | 13.5                |
As a result, products of the enterprises that survived the early 1990s reforms encountered a major financial burden and in fact became uncompetitive. However, passive assets, primarily buildings and utility systems, made possible their continued operation as their estimated durability at that time was 40-60%.

Reprofiling projects following were chaotic and occasional. Development companies lacked well-shaped hierarchical management and control systems for such projects. Moreover, there was no system-based analysis or feasibility assessment with regard to kinds, types and methods of such works.

However, at the same period, megalopolis authorities embarked upon development of regulations on and requirements to relocation of enterprises outside the city limits thus creating prerequisites for the preservation of production cycles. One of the leaders of such megalopolises became Moscow, where in 1999 the Mayor issued Order on Approval of the List of Enterprises and Organizations in the Territory of the Historical Center of Moscow Subject to Relocation, Reformation, or Liquidation No.517-RM. Similar resolutions were adopted in the early 2000s by many other Russian cities with million-plus-population, including Saint Petersburg, Omsk, Nizhniy Novgorod, Yekaterinburg, Ufa, to name but a few. However, no requirements were established with regard to dealing with various social problems in the course of implementation of such projects. There was an acute shortage of sports facilities, shopping centers, hotels and multipurpose leisure complexes (Table 2). It should be noted that as early as in 1999 Governmental Resolution No.1683-r introduced basic requirements to the number of social infrastructure facilities. In 2009, this Resolution was amended to take into account the realities of intensive development of the urban environment. Monitoring of the largest megalopolises showed the need for increasing the number of social infrastructure facilities by 25% to 300% [1].

Table 2. Number of Social Infrastructure Facilities in European and Russian Megalopolises

| No. | Project description                        | Qualitative indicators |
|-----|-------------------------------------------|------------------------|
|     |                                           | London | Paris | Moscow | Saint Petersburg |
| 1   | Museums                                   | 172    | 155   | 215    | 118 |
| 2   | Galleries and salons                      | 217    | 99    | 92     | 71  |
| 3   | Theaters                                  | 101    | 94    | 138    | 111 |
| 4   | Cinemas                                   | 430    | 210   | 162    | 91  |
| 5   | Concert halls                             | 67     | 44    | 41     | 18  |
| 6   | Discotheques and night clubs              | 216    | 178   | 135    | 192 |
| 7   | Swimming pools                            | 192    | 215   | 71     | 55  |
| 8   | Indoor sports complexes                   | 142    | 121   | 92     | 77  |
| 9   | Skating rinks                             | 29     | 12    | 21     | 19  |
| 10  | Markets                                   | 160    | 180   | 65     | 45  |
| 11  | Cafes and restaurants                     | 11,000 | 8,900 | 2,120  | 1,548 |
| 12  | Hotels, motels and camping grounds        | 3845   | 2845  | 350    | 220 |
| 13  | Number of hotel beds (thousand)           | 510    | 425   | 89     | 42  |
| 14  | Number of tourists in 2016 (million)      | 18.03  | 19.88 | 17.5   | 6.9 |

It is also worthwhile to note the lack of structuralized and scientifically determined control and monitoring systems for implementation of the reprofiling projects.

Such systems can be based on the synergy of organizational, technological, managerial and information reprofiling structures [2].

3
Implementation of the industrial facility reprofiling project requires operation of an integrated interaction system that consists of a large number of various investments, organizational, technological and information functional subsystems and modules [3]. By expressing the qualitative and quantitative properties of the said system elements it is possible to structuralize a consolidate list of initial data required for formation of an integrated organizational and technological design system and project management [6].

The system under review should be characterized by efficient coordination of integrated subsystems and interactivity between all project modules and the external environment. Notably, this condition should be ensured at all levels of the hierarchically developed system.

The system and the modules located at its various levels should be open and susceptible to prompt adjustment, supplementation and replacement.

The system should be responsive to impact of production parameters both of the project environment itself and the external environment impelling factors.

The system operation should be based on the principles of decision-making by project managers and the developer, as well as by supervisory authorities, the foreman and other project participants. The decisions made thereby should be reflected in the final technical and economic parameters of the process.

In this context, the important factor is ensuring the system’s ergonomics. For this purpose, it should be based on the maximum quantity of uniform and standard subsystems and modules and avoid establishing rigid framework of operations in the implementation of various stages of the project.

The system should be fully operational on various PCs, tablet computers and smartphones, and its software that forms the basis of the system under review should be updatable.

The main task of operation of the system should be reducing the duration and costs of reprofiling projects while ensuring their safety, quality and operational reliability [7;8].

One of the basic elements of such systems is information technologies. Symbiosis of the said system characteristics generated on the basis of positive experience of implementation of such projects coupled with a theoretically substantiated method of creating similar project management systems makes it possible to define the composition and establish the sequence of information technology elements of all participants in a reprofiling project [9].

It is appropriate to classify the main elements of the said information system into four functional and information macroblocks.

Macroblock I – Project autogenesis. The stage of formation of an idealistic model of a reprofiling project based on internal convictions of executive officers of the Investor, the Developer and the Technical Customer.

Macroblock II – Organization and design. Development of the design structure, resource allocation, calculation of the duration and costs of project implementation.

Macroblock III – Organization and management. Identification and structuring of requirements and standards, formation of integrated interconnections between individual system elements.

Macroblock IV – Information. Development of information structures of interconnections among all project participants; identification and ensuring uniformity of software and hardware for data communication [10].

Summary
In this manner, the proposed approach to the formation of a reprofiling project information system creates a unified determinate structure of all participants enabling data integration at all stages of implementation and an assessment of the response of the generated system by critical indicators. In addition, the described information system is open, sustainable and flexible in regard to internal and external impacts.

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