Formation of Methods for Assessing the Effectiveness of Industrial Areas' Renovation Projects

To cite this article: Azariy Lapidus and Topchiy Dmitry 2019 IOP Conf. Ser.: Mater. Sci. Eng. 471 022034

View the article online for updates and enhancements.

You may also like

- Information support for the management of forest lands, considering the development of a methodology for assessing the rational use of forest areas
  O Gvozdeva, E Kolbeneva, M Smirnova et al.

- Organizational and technological forecasting and justification of the final stages of the life cycle of the construction project
  E Gusakova

- Creation of an information-integrated project management system for reprofiling of industrial facilities
  D Topchiy and A Lapidus
Formation of Methods for Assessing the Effectiveness of Industrial Areas’ Renovation Projects

Azariy Lapidus 1, Topchiy Dmitry 2

1 Department of Technologies and Organizations of Construction Production, Moscow state university of civil engineering, Institute of Construction and Architecture, 129337, Yaroslavskoye shosse 26, Moscow, Russian Federation
2 Moscow state university of civil engineering, Institute of Construction and Architecture, Department of Technologies and Organizations of Construction Production, 129337, Yaroslavskoye shosse 26, Moscow, Russian Federation

89161122142@mail.ru

Abstract. As the urban environment develops, issues related to the zoning of megacities are becoming more acute. Environmental requirements are raised, the cadastral value of real estate objects is increased, for objective reasons, the wage fund of enterprises located on the territory of cities is increasing. All these factors create prerequisites for the withdrawal of industrial enterprises outside the city limits. Many of these enterprises were established several decades ago on the outskirts of cities, but as the urban environment developed, they found themselves in the central parts of the city, surrounded by residential and administrative quarters. However, the evaluation of the effectiveness of participants in the implementation of such projects has not been studied yet, and there is also no scientifically based system approach that allows to predict the required level of effectiveness of each participant, evaluate it at any time, in order to promptly adjust it, and also design a common level of effectiveness of the whole project. Five main structures involved in the implementation of projects for the renovation of industrial areas were singled out. To assess the effectiveness of each of them and further forecast their overall performance, it is necessary to study the individual parameters of each of them. It should be noted that the value of the allocated parameters of each of the participants in the course of the project implementation will change, moving from a larger one to a less significant one and vice versa. It is advisable to formulate common criteria for assessing the effectiveness of all participants, to create the possibility of a uniform approach to the analytical processing of the obtained parameter results. In the organizational and technological structures of the plots, the main single modules are the interrelations of the Information Support Is (information support) - Organizational and technological activities Eot (Organizational and Technological Events) - Organization structure Os (Organizational structure). Assessing the activities of each of the participants in the project, it is possible to identify and systematize individual parameters, assessing which it is possible to determine the effectiveness of the organization. For further analysis and modelling of processes, the identified parameters and their specific weights, it is necessary to group by 3 modules: information support; organizational and technological measures; structure of the organization. To determine the coefficient of influence of this parameter on the overall level of performance of the participant.
1. Introduction
In the industrialization period that began in the 50-s of the XX century, the territory of the outskirts of large cities was actively developed by industrial enterprises of various purposes. At the same time, urban environment gradually absorbed areas allocated for industrial facilities. Thus, industrial production was practically drawn to the central parts of cities surrounded by residential or office areas.

In the mid 90-s of the past century for the first time the isolated projections on the development vectors of Russian metropolitan cities began to evolve into specific concepts and road maps that eventually turned into urban development plans.

One of the elements of industrial development of megalopolises was the municipal programs for relocation of industrial facilities outside the city limits. That process was defined by several fundamental factors:

- Firstly, a substantial tension that affects the ecological situation in the city.
- Secondly, the high cadastral value of land and industrial buildings located thereon has a significant impact on the cost of production.
- Thirdly, the living standards and, accordingly, the wage level of employees residing in large cities add an additional factor to the cost of production.
- Fourthly, in large cities it is quite difficult and costly to provide logistic connections for delivery of industrial inputs and export of final products inside the city limits.

All these factors had an impact on the significant decline in the overall level of production in Russia associated with the reforms of the 90-s.

In Europe, the relocation of some enterprises outside the large cities coincided with the acknowledged necessity of their radical re-equipment and modernization. This country was behind with such measures by at least 50 – 70 years, which was the reason for the overall lag in technology.

In Moscow, in May 2004, the City Duma adopted the Decree “On the Legal Status of Industrial Areas and On the Status of Production Areas”. A reduced rent was established and other financial benefits for enterprises without time constraints on the preferences. This decision only exacerbated the city’s problems and led to withdrawal of significant redundant areas of industrial sites from operation. Only the recent Moscow development plan outlines a quantitative reduction of industrial zones and a noticeable reduction in their area. The motivation for such development of the city was obsolescence of the industrial processes, lack of manpower and the unfitness of the passive part of many enterprises for new process environment.

2. Methods and materials
In the second half of the XX century in the United States, the European Union, Japan and even in a number of other Asian countries a rapid reequipment of industrial enterprises began on the basis of the newest, more energy-efficient and environmentally friendly machinery. The characteristic features of the new production facilities are automation and robotization of most processes, computerized control and monitoring of the processes, miniaturization of many types of equipment.

In the process of technical reequipment it becomes apparent that new production lines cannot be integrated in the old building structures, and the foundations of buildings do not support the new equipment. This was the reason why the car factories in the Leningrad Region were built on an unoccupied territory, in spite of the vacant buildings of the machine-building enterprises that were offered. For the same reason the production of Renault cars was set up in a new building on the territory of the Moskvich plant and the old buildings were occupied by various companies operating in the fields far from car manufacturing. This was also the case with the ZIL, Serp I Molot, Znamya Revolutsii and Stankolit factories.

Industrial facilities in major cities occupy up to 20% of the territory. In Moscow the amount is 19%, and only 8.9% is reserved for motorways, while in Paris these indices are 12% and 12.5%, respectively.
Pursuant to the experience of West European cities and the judgment of our urban architects, the solution of many problems that Russian cities are facing will be associated with a more efficient use of industrial territories, densification of industrial areas, shutdown of enterprises that do not meet environmental and sanitary standards, reallocation of part of industrial territories for civilian needs, reconstruction of certain industrial buildings and their readjustment into civilian properties.

One of the topical issues for large cities in Russia is identifying redundant territories for new residential construction as well as construction of social and public facilities. Many large European cities have more green spaces and open water surfaces per person. It is quite important that green spaces be located discretely in the city's districts (squares, boulevards, small parks). Increasing the green space area is a steady trend in the capitals and major cities of Europe and the US. It is achieved due to the reduction of territories occupied by old production facilities, warehouses, railway infrastructure facilities, or power lines. Large Russian cities have very substantial reserves in this respect, figure 1 confirms such possibilities.

![Figure 1. Ratio of urban territories of various purposes](image)

The structure of passive productive assets (auxiliary part of fixed productive assets, such as buildings and constructions not directly involved in the production process) can be inferred from indirect indicators. These include data on manpower changes and manufacturing rates of certain types of industrial products according to public sources. For instance, the weaving industry in Moscow grew 2.5 times from 1913 to 1940, and the number of workers doubled. From 1940 to 1970, these indicators grew 2.7 and 2.2 times respectively. Over the next thirty years, these indicators declined to 1.4 and 1.3, respectively, to the data of 1970. This is indicative of an extensive character of this industry’s development in Moscow.

Implementation of a project for repurposing an industrial facility presupposes that there is a complex system of interactions in place that consists of a large number of different functional subsystems and modules – investment, organization and technology, information. By evaluating qualitative and quantitative characteristics of the described elements of the system we can structure a unified list of initial data required to create an integrated system of organizational and technological design, as well as project management.
The system under consideration should provide effective coordination of integrated subsystems, mutual interactivity of all project modules and the external environment. This condition should be ensured on all levels of the system hierarchy.

The system, as well as the modules on its various levels, should be open and transparent to ensure the possibility to timely adjustment, updating or amending. The system should respond to the effects of production parameters of both the project environment and the external drivers of the environment. The basis of the system’s operation should be built on the principle of decision-making by project managers, the developer, as well as regulatory authorities, site supervisor and stakeholders. The adopted decisions should reflect on the final technical and economic parameters of the process [1].

Along with that, the ergonomics of the system should be regarded as a factor of no small importance, and for that purpose the system should be built from the maximum number of homogeneous and standard subsystems and modules and not limit the activities of the contractor during the implementation of various stages of the project.

The system should be compatible and applicable for mainstream use on various computers, tablets and smartphones. It is also necessary to provide for updating of the software complex on which the system at issue is based [2].

The main purpose of the system should be reducing the time and cost of implementing the facility repurposing project, while ensuring safety, quality and operational reliability of the facility. One of the basic elements of a system like that is information technology. The symbiosis of the described characteristics of the system, built upon positive experience of implementing similar projects, together with a theoretical, scientifically grounded method of creating similar project management models, makes it possible to define the scope and line up the chronology of information technology elements of all participants in a repurposing project. It is practical to group the main elements of this information system into four main functional and informational macroblocks (figure 2).

![Figure 2. Functional and informational macroblocks of the information management system of a facility repurposing project](image)
• Macroblock I – Project Autogenesis. The generation phase of an idealistic model of a repurposing project based on the internal beliefs of the leaders of the Investor, the Developer and the Technical Customer.

• Macroblock II – Design and Organization. Development of the design framework, allocation of resources, calculation of project life and implementation costs.

• Macroblock III – Organization and Management. Identifying and structuring requirements and standards, building up integrated interconnections between individual elements of the system.

• Macroblock IV – Informational. Development of information structures for communication and interaction between all project participants; identifying software and technical tools and interfaces of information exchange, as well as ensuring their uniformity.

Thus, by applying the proposed approach to the development of the information system of a repurposing project, a single deterministic structure of all participants is created [4]. Providing thereby the possibility of data integration at all stages of implementation and evaluating the response of the created system on critical indicators. In addition, the described information system is not only open, but also provides flexibility to internal and external influences, and is sustainable. Therefore, it is obvious that in order to form a systematic approach to the processes of renovation and repurposing of industrial areas, it is necessary to identify and formulate a systemic factor. This problem becomes the concept of the System, as well as its application in the research work devoted to the development and formation of a unified system of repurposing industrial facilities.

The main features of the system under development include a number of underlying principles as follows:

• A theoretically developed system can be of general nature if it combines all participants and all isomorphic regularities of interaction processes and mechanisms for various system modules;

• The identified isomorphism of various system modules can be assessed provided that the isomorphism criteria are sufficiently weighty and significant and the number of criteria can be assessed and mathematically analyzed;

• Development of a General System Theory requires identification and description of a systemic isomorphic factor.

The organizational and technological system of industrial facility repurposing, admittedly like any other system that describes interrelations between participants in construction projects, is based on the mathematical system theory. In this process, the system itself is used not only for researching into the processes of project implementation, but also for explanation of various current processes. The idea of mathematical model implementation was detailed in the works of Mihajlo Mesarovic, who formulated the sequence of application of the mathematical model in the study of characteristics of the model under examination (deduction method) or by using computer-aided modelling [4]. Thus, the system approach methodology structure is arranged as follows:

• Formalization. System development on the basis of a statement of work;

• Deduction. Research into the developed system;

• Interpretation. Study of the attained results of the system performance.

Thus the sequence of the mathematical theory application in the structure of the organizational and technological system of interrelations between participants in the repurposing exercise is based first on theoretic formation, followed by its functioning in a particular facility and then followed by an assessment of the outcome and other phenomena [5].

3. Results and discussions
The outcome is subject to a comprehensive analysis as a decisive element of the system functioning [6]. First of all, the whole system functions and the various resulting variation series should be presented in various terminological results thus noting the significance of the mathematical model.
This phenomenon can be described by the following points:

- Kind and type of the expected outcome;
- Stages of attaining the outcome;
- The system element (module) that produces the outcome;
- Assessment of validity of the attained outcome.

In fact, the above points are described by the system basic mechanism and at the same time they include the whole purpose of establishment of the organizational and technological system [7]. It should be noted that information support and organizational structures as the main elements of the facility repurposing organizational and technological system include various element forming modules combined by a common attribute and internal relations. It is also worth noting that an important characteristic under examination is a “degree of freedom” both of the modules themselves and the system elements in total and the system itself. The module and correctness of its operation can’t be assessed without determination and formalization of the “degree of freedom”, because the information that it produces will be excessive and defy processing and structuring. In this process, all modules with a similar degree of freedom that fail to produce significant results should be eliminated [8].

4. Conclusions
The attained outcome is the main and integral element of the system functioning, a tool of streamlined impact on its various elements and modules. If the elements operate in accordance with this principle, such system is called functional. Thus it can be argued that the “managing system” assumes positioning of the managed facility not inside, but outside it. Dialectically, the term “Management system” implies that it is full-fledged and all-sufficient.

References

[1] Information interaction between participants in a construction project as an additional factor of assessment of the organizational and technological potential. Lapidus A.A. Moscow. Bulletin of the Moscow State University of Civil Engineering, p. 101-106, 2016.

[2] Lapidus A. A. Formation of an integrated potential of organizational and technological solutions by decomposition of the main elements of a construction process // Bulletin of the Moscow State University of Civil Engineering, Vol. 12, p. 114-123, 2016.

[3] Lapidus A.A. Formation of occupational direction of construction professionals based on analysis of their sports preferences // Physical culture theory and practice, Vol. 5, p. 33-34, 2017.

[4] Mesarovic M. Cybernetics of Global Change: Human Dimension and Managing of Complexity. UNESCO MOST policy papers, 1996.

[5] Organizational design and management of large-scale investment projects. Lapidus A.A. Moscow, Moscow Publishers, Vol.9, 1997.

[6] Reengineering and repurposing of production buildings. Topchiy D.V. Moscow, ACB Publishers, 2008.

[7] Topchiy D.V., Skakalov V.A. Structural and functional modelling of multilevel and multicriterial connections in organizational, technological and managerial structures and information support in construction supervision of repurposing of industrial facilities // Scientific Prospects, Vol. 10(97), p. 44-50, 2017.

[8] Topchiy D.V., Tokarskiy A.Ya. Improving organizational and technological reliability of facilities under repurposing in construction supervision // Science and business, Vol. 10 (76), p. 15-19, 2017.