

Integrated organizational management system of a construction company engaged in industrial area redevelopment

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Abstract. A large number of large industrial cities around the world are characterized by the presence of industrial sites in the Central part of the city and areas close to the center. A significant part of these zones have lost their relevance and are not used as production facilities, but function as rental businesses. The relevance of the study considered in this article is due to the need to create an organizational and technological model for the development of project documentation for the redevelopment of industrial facilities in the absence of Federal and regional programs in Russia that affect this area, as well as the lack of a regulatory framework for regulating the activities of project organizations that develop the above projects. The article deals with the General principles of developing an organizational and technological model that allows evaluating and optimizing the designer's activity when repurposing industrial objects, as well as aimed at improving the design processes of such objects. For scientific, methodological and system-technical bases of designing organizational structures of enterprises and organization of production processes of modeling re-profiling of industrial territories, it was necessary to solve the following tasks: study and generalization of foreign and domestic experiences of redevelopment of industrial zones; identification of actual problems in the design of redevelopment of industrial territories; study of factors that affect the effectiveness of the designer; establishing the degree of influence of the identified factors on the quality of the project documentation produced. The parameters and organizational principles described in the article are taken into account when re-profiling industrial objects in the urban environment of large Russian megalopolises.

1 Introduction

The organizational system of an entity engaged in an industrial area comprehensive redevelopment project is reviewed on the basis of information provided by the Customer and research work. Performance efficiency analysis and development of an appropriate organizational structure that would consolidate and coordinate the work of a large number of professionals employed by the company with a view of accomplishing the set tasks as scheduled, at the required quality level and within the established financial and other

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resources require review of the available documentation, collection of key information and ensuring conceptual interconnections in the form of strategic initiatives (Figure 1).

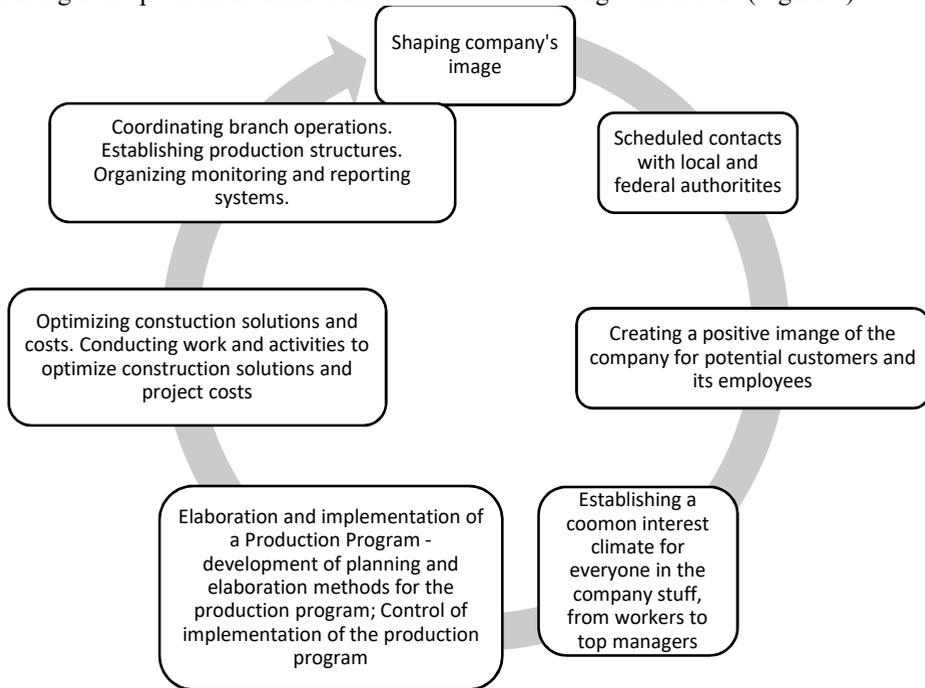


Fig. 1. Strategic initiatives

2 Materials and methods

Preparation and implementation of an industrial area redevelopment project is an integrated and complex process to be divided into separate stages [1]. In this case, the project is understood as an entire set of redevelopment operations and all related activities. The project concept is amalgamation of its objectives; functional and space solutions as the core of the entire project; external environment of the project; project participants; distribution of tasks, responsibilities and risks borne by each of the participants. The company can be concurrently involved in several projects with similar characteristics (civil engineering, road construction, industrial construction, engineering infrastructure facilities). As a consequence, a unified organizational structure can be formalized by separating individual operations therein (Figure 2).

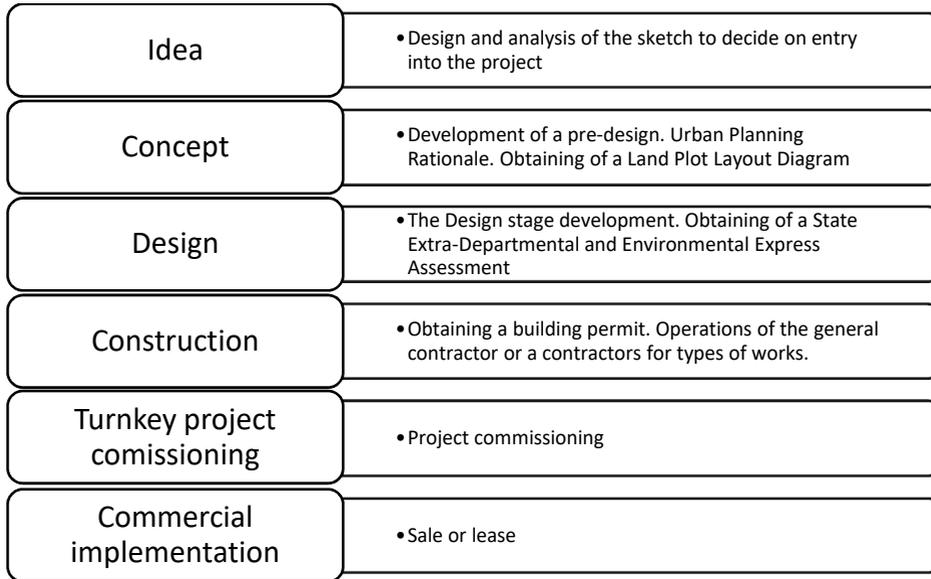


Fig. 2. Technological operations at development project stages

Due to the fact that major facilities subject to industrial area redevelopment are hierarchically structured with different numbers of levels and different target functions (functional efficiency criterion), the most efficient solutions require multi-level and multi-objective systemic optimization with account of links in structural and functional subsystems [2]. However, the necessary assessment level for such links remains beyond the limits of comprehensive analysis due to the difficulties in processing large data volumes. However, recent years have been witnessing the development of new hardware, generation of automated data banks, systematization of statistical data on links in large multilevel construction systems, and the emerging possibility of fast analysis of large data volumes using supercomputers. As a result, systemic optimization of industrial area redevelopment projects can now be based on the necessary pre-requisites and conditions. In practice it can be implemented as follows [3].

Traditional objective-setting in organizational and technological structure optimization is reduced to identifying system parameters described by a mathematical model and relationships among elements as follows:

$$R(x_1 \dots x_n) \leq 0 \tag{1}$$

where the objective function F would have an extreme value

$$F(x_1 \dots x_n) = F_{\min/\max} \tag{2}$$

Here $i = 1, \dots, n$ is the number of elements in the system.

The formation of analytical links among the multi-level system elements under review requires considerable labor costs [4]. It is a complicated exercise, which is not always expedient and is frequently impossible. It is much more efficient to create alternative options for the system elements, to assess them by a certain criterion, and then to create a system by integrating the selected elements, just as it is done in practice. In spite of such tolerances and simplifications, this challenge is still rather complicated and labor-consuming, but it can now be tackled by system analysis methods in the following order:

- 1) set an optimization goal;

- 2) identify individual system elements and all potential factors of influence on the final result;
- 3) create an alternative tree of goals, taking into account the greater variability across the hierarchy;
- 4) evaluate system optimization criteria for generating alternative organizational and technological solutions;
- 5) analyze the obtained alternatives in the targets tree and remove unnecessary options, leaving the key ones;
- 6) synthesize the system using the created goal tree and generate a solution to the problem as a whole.

The target function in the multi-criteria evaluation of an option of a certain level in the targets tree is as follows:

$$F_j = \sum_{i=1}^n \beta_i \delta_i, i = 1, \dots, k. \quad (3)$$

In this case, the system criterion for all elements of n levels can be expressed as follows:

$$\Phi_j = \sum_{j=1}^m F_j, j = 1, \dots, m \quad (4)$$

Here k is the number of criteria; β_i - weight coefficient; - criterion; m - number of options.

The entire search for alternative solutions and the comparison of the system criteria of options enables selection of individual elements of the target tree with the extreme values of the criteria, that is performing systemic multi-criteria and multi-level optimization and choosing the optimal solution [5].

3 Research result

Enhancing the efficiency of industrial area redevelopment projects requires new cost-effective and innovative organizational and technological operational solutions. For this reason, the great importance is given to scientific, technical and economic forecasting in designing, information modeling, and construction and installation works for redevelopment of industrial areas, as well as practical use of these forecasts. Application of scientific forecasting makes it possible to carry out a preliminary assessment of the effectiveness of practical use of the proposed design, organizational and technological solutions and to improve the quality level of the project as a whole [6].

Design of the organizational and technological system is based on the use of management modules that characterize production, technical and technological relations in projects of renovation and redevelopment of industrial areas [7]. The organizational system of such macrostructure is required to:

- Reflect the organizational, technological, and resource relations among individual components of the project;
- Provide the planning basis for the whole set of operations within the company's projects;
- Be flexible and responsive, quickly adaptable to possible changes in design solutions not affecting major structural elements or connections.
- Thus, the organizational structure of an industrial area redevelopment project that creates an integrated interconnection among basic modules and stages is formed into a unified organizational block.

- The principles of organizational structures are based on common modules for management, analysis and control, as well as on the possibility of rapid intervention and changing flexible system links.
- Analysis of the existing organizational and technological system of the company and formation of organizational and technological modules require the following:
 - Identification of particular features of the organizational and technological system;
 - Analysis of the organizational and technological system of the company represented schematically;
 - Analysis of the organization of operations, including task assignment, task management, and coordination of interaction among departments;
 - Responsibility allocation analysis;
 - Information exchange organization;
 - Problem areas.
- In accordance with the current system formation concept of companies involved in large-scale projects, the scope of operations at construction stages includes the entire work package associated with:
 - Preparation for construction;
 - Analysis of design documentation;
 - Work scheduling;
 - Planning the production needs for resources, machines, mechanisms, and personnel;
 - Planning the financing needs;
 - Operations performance;
 - Delivery of completed works to the customer;
 - Delivery of the project to the customer;
 - Participation in the project commissioning.

Thus, the hierarchically determined structure of an organization involved in redevelopment of industrial areas must conform to the company's organizational and technological system to ensure reliability, flexibility and sustainability [13-14].

4 Conclusion

Each of the major stages of the project is split into separate phases, which, in turn, are divided into specific tasks. Participants in the projects, each of whom has a certain function to perform in accomplishing project tasks, are selected in accordance with a variety of conditions and factors determined by the project objectives, its external environment, and project parameters. The system is based on the modular principle providing for identification and description of individual standard module processes. The modular structure of the project system allows to improve visibility, increase flexibility in planning, monitoring and possible adjustment of the entire project as a whole and its individual elements, as well as to simplify information flows throughout the entire construction system [8-9].

Organizational and technological modules are formed on the basis of:

- Analysis of existing business processes;
- Identification of the main problems of business processes and formation of proposals for local improvements;
- Modeling of business processes and identification of controlled parameters;
- Action planning for process implementation;
- Management problem tackling algorithm;
- Appointment of an officer responsible for each stage of the process. Appointment of a manager for each business process who will manage the process and the allocated

resources; be responsible for the results in quantitative and qualitative terms; report on the results;

- Determination of process inputs and suppliers for each of them, outputs and target consumers;
- Development, documentation, and description of the sequence of actions (technology) of the process implementation, as well as inclusion of the relevant provisions in the job descriptions. Development of business process flowcharts.
- Systemic control of sequential execution. Development of process control elements. Specification of objectives, development of a scorecard and a parameter reporting system, types, forms and procedures for motivation of contractors and the owner.

The development of the organizational and technological system requires the following:

- Preliminary division of the production process into stages;
- Establishment of process modules;
- Development of a reference system alternative with embeddable modules;
- Modeling of organizational and technological system alternatives;
- Calculation and selection of the optimal alternative.

Further adjustment of solutions taking into account the dynamics of the external and internal environment of the project.

Structuring the production process of the project and highlighting its structural elements enables the creation of a visual model to be used as the basis for developing the company's organizational system. Building a company's organizational and technological system from modules and further use of individual modules based on established coordination and synchronization procedures is one of the most important principles for integrating construction phases in large projects.

Thus, building the organizational and technological system of an organization typically includes:

- Identification of key activities by key factors;
- Determination of tasks to be achieved in attaining the objectives of the selected key activities;
- Creation of a value chain system integrating all the key activities into a logically coherent interaction business scheme;
- Combining activities into lines of activity and selection of structural units responsible for lines and types of activity;
- Schematic representation of the company's organizational and technological system ;
- Regulatory action on the organizational and technological system.

Formation of the company's organizational and technological system includes development of recommendations on changes aimed at significant improvement of efficiency of the company's operations, such as recommendations on:

- Alterations in the management system;
- Alterations in the management method;
- Alterations in the project procedures;
- Regulatory action on the functional procedures.

The organizational management task is to create an information system that ensures effective monitoring of the project performance indicators, evaluation of the difference between their design and actual values, decision-making and possible adjustment, related coordination of interaction between project participants, creation, updating and transfer of the project information database, and its use in all structural elements of the project [10].

To ensure that the work of all project participants conforms to the contractual deadlines and costs and to achieve maximum efficiency of the company's activities thereupon, it is necessary to:

- Determine the structure of key subdivisions, establish clear relations among them and distribute rights and responsibilities;
- Develop regulations on business interaction among subdivisions;
- Organize effective information support;
- Organize an effective accounting and progress monitoring system for operations and use of resources;
- Bring the new processes to the notice of subdivision staff;
- Bring the changes to the notice of the staff of related subdivisions.

The concept of development of an integrated industrial area redevelopment project is based on practical approaches to achieve the final outcome as shown in Figure 3 and includes:

Coordination and cooperation of all project participants having a common goal, but individual tasks, interests and responsibilities;

Formation of a flexible production management system providing for broad independence of the parties involved and strict control of intermediate and final performance indicators;

The lowest possible loss of time for auxiliary routine procedures with clear organization of registration, storage and use of the information base at all management levels.

Forecasting in the field of redevelopment of industrial areas and justification and selection of optimal and promising urban-development options offering labor, financial, material and energy savings are possible subject to appropriate mathematical models and software. Forecasting, justification and selection of solutions are labor-intensive operations requiring significant labor costs and high skills of designers and can be implemented only in collaboration with process engineers.

Analysis of the company's organizational structure results in a uniform implementation algorithm for industrial area redevelopment projects (Figure 3).

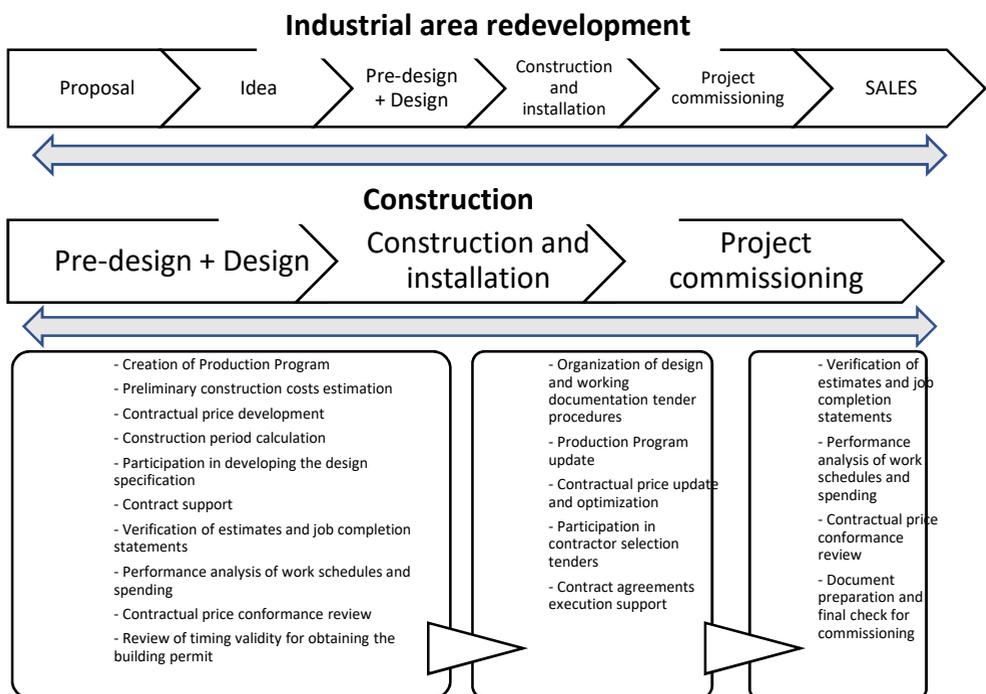


Fig. 3. Algorithm of industrial area redevelopment projects

Thus, the rational structure of production processes and conformity to project solutions and requirements to hardware and skills are subject to a wider analysis of all company operations.

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