.

REICE
Revista Electrónica de Investigación en Ciencias Económicas
Abriendo Camino al Conocimiento
Facultad de Ciencias Económicas, UNAN-Managua

Vol. 8, No. 16, Julio – Diciembre 2020 REICE ISSN: 2308-782X

http://revistacienciaseconomicas.unan.edu.ni/index.php/REICE
revistacienciaseconomicas@gmail.com

Organizational and Technological Modeling of Industrial Facility Redeployment

Modelización organizativa y tecnológica del redespliegue de instalaciones industriales

Fecha recepción: junio 20 del 2020
Fecha aceptación: septiembre 15 del 2020

Azariy Lapidus
Moscow State University of Civil Engineering,
Moscow, RUSSIAN.
Correo: azariy.lapidus@yandex.ru
ID ORCID: https://orcid.org/0000-0001-7846-5770

DOI 10.5377/reice.v8i16.10664

Abstract.
Redeployment of industrial facilities allows companies to optimize their structure while also creating a competitive environment in the service sector. In addition, during the redeployment process, the property complex undergoes optimization. Because of releasing production, the costs could be reduced by preserving, selling, and leasing production space. However, to achieve and strengthen long-term competitiveness, companies are forced to adjust their activities with an emphasis on the changing demands of the period. Since the world is constantly changing, it is very important to respond to these changes expediently and quickly. So far, international practice and experience of redeployment in the Russian Federation have shown that it is one of the most difficult managerial tasks. During this process, many restrictions and unique characteristics of the company, where they are implemented, should be considered. Consequently, it must be performed only in the presence of the clearly defined goals, redeployment concept, and an understanding of each stage and the methods to be observed. This is a relevant study because the model of the work performed during redeployment allows this process to go as smoothly and efficiently as possible allowing the company to adapt to new market conditions. However, the topic of the study is poorly covered nowadays. In fact, many sources consider a redesigning strategy only as a special case study of a restructuring strategy or a strategy for updating the fixed assets. Therefore, regulatory documentation for capital construction projects as well as redeployment facilities should be improved.

Keywords: Redeployment of industrial facilities, Scientific and technical renovation substantiation, Redeployment of industrial areas, Urban deployment, Construction control

Resumen.

La redistribución de instalaciones industriales permite a las empresas optimizar su estructura y, al mismo tiempo, crear un entorno competitivo en el sector de servicios. Además, durante el proceso de redespliegue, el complejo inmobiliario se optimiza. Debido a la liberación de la producción, los costos podrían reducirse conservando, vendiendo y alquilando el espacio de producción. Sin embargo, para lograr y fortalecer la competitividad a largo plazo, las empresas se ven obligadas a ajustar sus actividades con énfasis en las cambiantes demandas del período. Dado que el mundo cambia constantemente, es muy importante responder a estos cambios de manera oportuna y rápida. Hasta ahora, la práctica internacional y la experiencia del redespliegue en la Federación de Rusia han demostrado que es una de las tareas de gestión más difíciles. Durante este proceso, se deben considerar muchas restricciones y características únicas de la empresa, donde se implementan. En consecuencia, debe llevarse a cabo solo en presencia de metas claramente definidas, el concepto de redistribución y una comprensión de cada etapa y los métodos que deben observarse. Este es un estudio relevante porque el modelo de trabajo realizado durante el redespliegue permite que este proceso se desarrolle de la manera más fluida y eficiente posible permitiendo a la empresa adaptarse a las nuevas condiciones del mercado. Sin embargo, el tema del estudio está poco cubierto en la actualidad. De hecho, muchas fuentes consideran una estrategia de rediseño solo como un estudio de caso especial de una estrategia de reestructuración o una estrategia para actualizar los activos fijos. Por lo tanto, se debe mejorar la documentación reglamentaria para los proyectos de construcción de capital y las instalaciones de redespliegue.

Palabras claves: Redistribución de instalaciones industriales, Justificación de la renovación científica y técnica, Redistribución de áreas industriales, Despliegue urbano, Control de obra

Introduction

Redeployment is the transfer of production coefficients from one area of use to another. For example, an industrial building redeployment is a change in its functional purposes to change the operational qualities, increase the profitability of the facility, and consolidate this procedure legally in the relevant government institutions (Oleynik et al., 2016; Zhadanovsky and Sinenko, 2014).

Incompatibility of industrial companies built over time in the Union of Soviet Socialist Republics (USSR) with today's requirements, significant technological progress, economic reform, and transition to the market principles for evaluating efficiency imply the fact that their target and functional purposes must be changed. However, technical conditions of many industrial buildings in the Russian Federation allow them to be in operation for more than one decade. Most of these buildings are in settlements. Therefore, development of cities led to a significant increase in their areas, as a result of which industrial companies once built on the outskirts were within or even in the central parts of cities (Roodman et al., 1991).

Literature Review

It is well-known that the scientific research in the field of improvement and adaptation of modern technologies and engineering methods of assessment of the load-bearing capacity and reliability of buildings have been carried out by specialists of RAASN under the leadership of V. A. Ilyichev in MGSU, Kuibyshev under the guidance of Dr. Telichenko V. I. (at the Department of Technology of Construction production, under the leadership of Dr. Ter-Martirosyan Z. G. & Ukhov S. B. at the Department Of mechanics of soils and bases). Notably, scientific and practical work is carried out under the leadership of Dr. Schreiber A. K. and Schreiber K.A., Ph. D. of Lame Yu. M., experts of the Russian Institute of General Academy under the guidance of Professor B. V. Gusev, the specialists of the International Ecological Academy under the leadership of Professor R. I. Vokova.

Material and method

Redeployment of production companies means that construction costs and provision of new facilities within a city. Despite many industrial buildings that have lost their effectiveness and relevance, as along with significant interest from investors in these facilities, the field of construction redeployment remains poorly studied. Therefore, it is currently necessary to conduct studies on the selection of effective models for monitoring organizational and technological processes during the redeployment of industrial buildings (Graham, 2003).

In general, there are three fundamentally different types of changes in commercial property: “reconception”, “reconstruction”, and “redeployment”. During reconception of a facility, changes would not influence the structural elements of a building; only the concept of functional zoning and the building would change. During reconstruction, structural elements of an industrial building would change. In this case, the shape and appearance of a facility as well as the size of the areas may change. An example is the reconstruction of the Central Children's store on Lubyanka in Moscow. Finally, with the redeployment of an industrial facility, its purpose changes, the main production “deployment”, as indicated above in this work, due to technological progress and the population needs changing over time. New non-capital partitions at the facility refers to redeployment, in which the height of the premises is being changed and new technological and production equipment are being changed and installed.

It is quite difficult to redeploy an already constructed industrial facility. Making changes in the functional purpose of a facility and its spatial and other characteristics refers to a reconstruction. The procedure for obtaining initial permits is as the same as the procedures for a new construction project and includes the development and approval of urban planning documentation (territory planning project and/or UDP), the change in the purpose of leasing a land plot for design and construction in compliance with UDP parameters, design and examination, and obtaining a construction permit. The deadline for obtaining initial documentation authorizing redeployment is the same as for new construction. Upon the market analysis, this process may last seven to ten months up to a year and a half or more. In general, regardless of the time allocated for designing, changing the deployment of an industrial facility can last from one to three years (Shinri and Masamichi, n.d.).

Without prior permission or approval, the owner of a redeployment facility may independently choose the type of the permitted use of the facility from those fixed by town-planning norms, if the building complies with technical regulations governing the chosen type of activity.

Redeployment, like any construction process, is associated with certain organizational and technological operations, both in the field of management and in the field of construction and installation works. These include (Lapidus, 2014):

Conducting surveys before the construction and installation;

Preparing initial permits for the work performance during redeployment;

Drawing up sets of the relevant technological maps for various construction processes;

Determining the work duration;

Supplying building materials for the work; and

Monitoring the implementation of organizational and technological processes.

They also include (Lapidus and Govorukha, 2015):

Conducting construction dismantling works on the site;

Constructing new capital and non-capital structures;

Strengthening structural elements of an industrial facility;

Checking and redirecting engineering networks; and

Installing and commissioning industrial technological equipment.

Since the scope of processes for redeployment of industrial facilities has been poorly investigated and the range of construction, installation, and management is extensive, it is necessary to make the right choice of the control methods and develop a model to assess the degree and effectiveness of the methods before starting work. Here, the modern control methods will be considered (Abramov et al., 2016).

Direct construction monitoring during the work can be continuous; that is, checking the building structure after a certain operation or when construction is complete. It may also be monitored in a selective way, which involves examining a specific integral part of the structure (Abramov, 2019).

Continuous control refers to a situation when a technological process does not provide sufficient stability of the specified dimensions and other design parameters or when heterogeneous quality of materials or components are observed after technological operations, on which the accuracy or other quality indicators are largely dependent, as well as when a complex or highly responsible design are checked. In this situation, full construction control by the manufacturer (the supervisor) is not always justified in economic terms, since he will be distracted for a considerable time from his main responsibilities; that is, direct operation and monitoring.

The situation is different when using the selective control method. The team leader can pay more attention to the issue of maintaining the technological process stability ensuring a flawless operation. When sampling, it is important to determine the optimal sample of structural elements. Under ordinary sample control, its size is determined based on the analysis of several samples of various structural elements with this name without an estimated justification. Moreover, a statistical control method is used for a more accurate and reasonable sample size determination. Statistical control is mainly used when checking critical and numerous structural elements (load-bearing columns, building pylons). However, the selective control method can provide sufficient quality information only if a process is stable. In fact, the method is most appropriate when organizing workplace monitoring for a flawless operation.

Such types of control are operational (after each technological construction operation) and group (after a group of operations). Operational control refers to the situation when the most critical work is performed or when the quality of one construction process significantly affects the subsequent quality of the entire structure. Actually, several sequential operations are recommended if it is verified that they with the group method will reduce the control complexity (Lapidus and Abramov, 2018).

Ensuring the functional quality of the construction products is a complex task, the solution of which is a constant transformation of the properties and conditions of the construction objects for a long period.

The considered period has been named "a life cycle of construction production" (including construction objects of industrial appointment).

According to Figure 1, the life cycle of a construction object in the form of a temporal-logical structure has been characterized by successive changes in the States included in the structure (stages, periods).

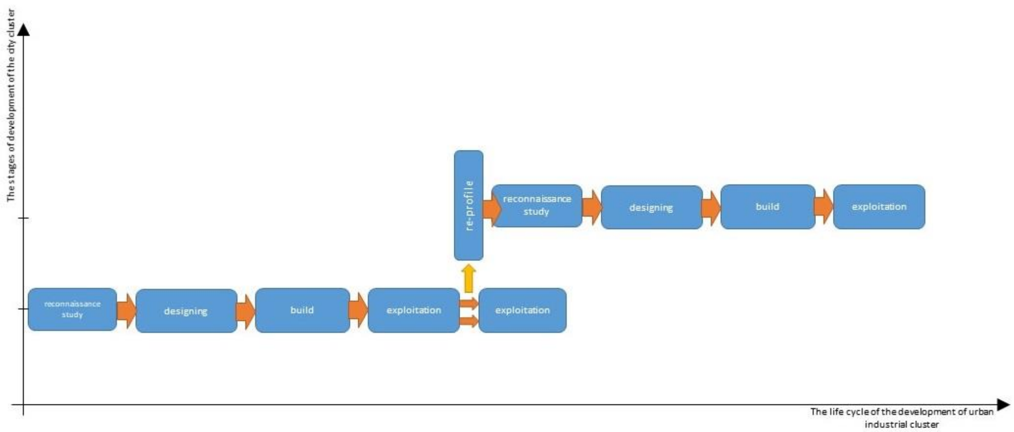

Figure 1: Life cycle of the object of construction of industrial functional purpose

After conducting a scientific study of the experience of organizing construction production and re-profiling of industrial facilities, the authors formed the life cycle of implementing investment projects to change the structure of production areas.

The life cycle of the industrial urban cluster has the form of a consistent, hierarchical, strictly oriented structure and includes the following main stages of development (Surya et al., 2019):

- Reconnaissance study,
- Designing,
- Building
- Exploiting.

During the operation of buildings and structures, a decision is made to redesign the production complex. Repurposing (re-profile) can be associated with the modernization of production, changing the functional purpose of buildings, while the industrial buildings themselves remain, or the marginal repurposing of the territory because of its industrial purpose to civil.

One of the features of the life cycle of construction products is the fact that the effectiveness of each subsequent stage (period) is determined by the quality of organizational and technological solutions implemented in the previous period.

For example, indicators of functional and technological efficiency of production processes, as well as the state of bearing and enclosing structural elements of an industrial building or structure (for example, up to the period of time corresponding to the onset of the first planned repair) are characterized by the quality of adoption and practical implementation of composite and structural organizational and technological decisions developed at the previous mandatory stages of the type; that is, "design" and "construction". The quality of design, organizational, and management decisions affect the performance of functional quality of the construction object (the effectiveness of decisions taken and implemented);

therefore, it is possible to adequately assess only at the end of all (but primarily mandatory) periods of its life cycle.

The stage of the life cycle of the type "reconnaissance study" provides for a set of measures aimed at the analysis of economic and engineering factors necessary to make a fundamental decision on the feasibility of the formation of construction products of a certain functional purpose.

The economic survey intends to determine the economic feasibility of construction and operation of the construction object in a certain geographical area.

Reconnaissance study indicates a set of studies of the area or site of construction, which are carried out in order to identify specific environmental conditions (artificial and natural) and prepare initial data for development and decision-making during the subsequent periods of "design" and "construction".

In fact, "Design" is a complex of works and processes (on the basis of economic and engineering surveys) during the implementation, of which the development of a project (technical documentation) is carried out and displays the solutions necessary for preparation and construction of the construction object under conditions of the construction site.

Design works based on the design assignment and depending on the complexity (uniqueness) of the construction object are performed in one (working draft) or two stages (draft and working documentation).

The quality of the design decisions is subject to a special procedure (in the final part of the period "Design"); that is, examination of the composition and content of sections of project documentation. Examination of the project is actually an effective tool for monitoring the results of design, and the result of the examination may well be a conclusion to finalize the project documentation or re-design.

"Construction" (capital construction) defines the format of practical implementation of the design solutions of the construction projects in one of the possible formats of:

- New construction,
- Reconstruction,
- Expansion, and
- Technical modernization.

New construction is the most common method of construction facilities, which allows the use of both widespread and progressive, innovative construction methods and technologies for typical and unique construction facilities for industrial purposes.

Reconstruction, expansion, and technical modernization are ways to restore or improve the quality of capital construction projects that have been operated for some time.

"Exploitation" refers to the operation of the facility construction of industrial purpose in the installed environment and is subject to the regulated complex of measures aimed at maintaining the quality of the completed project and its structural elements:

- Reliable (first of all, trouble-free and durable) operation of individual structural elements and the object as a whole,

- Ensuring normal sanitary and hygienic conditions and parameters of the internal space (temperature and humidity conditions of premises),

- Ensuring compliance with fire safety rules and regulations,

- Reduction or minimization of the environmental load from technological processes and/or life processes, and

- Recoveries or restoration of the lost quality by means of systematic supervision and carrying out planned repair works.

Operation of the constructed construction objects (including objects of industrial purpose) if the actual characteristics correspond to the established values. To ensure a proper technical condition of the construction object, a system of operational control and repairs should allow assessing and maintaining the technical condition and quality and reliability indicators at a given level.

In most cases, it is the duration of operation (service life) that determines the life cycle of the construction object, and, therefore, it is an objective criterion or indicator of the quality of design solutions and the quality of construction production.

"Repurposing" (re-profile) (and other periods of the life cycle of the species: "conservation", "major repairs") determines possible improvement (restoring) of the lost or insufficient quality, both of individual construction projects and areas of industrial zones of the urban environment.

A meaningful extension of the duration of operation and/or change in functional quality indicators displays support for material and/or intangible value of the corresponding production facility by the original design decision, which is not a mandatory period of its life cycle.

One of the possible ways to ensure the long-term functioning of industrial buildings and structures (prolongation of the life cycle) is the possibility of "converting" architectural, artistic, structural, and engineering-technological features into signs of historical (or intangible) value, which distinguishes the objects of cultural and historical heritage.

Quite a large number of industrial construction objects (production zones) of the past historical epochs (pre-industrial, industrial, and early post-industrial periods) have preserved their material and intangible features and are able to adapt to modern conditions, preservation, and further use.

Here, reasons of why it is possible to preserve and extend the life cycle of the industrial facilities (primarily historical buildings and structures) into rational and emotional categories will be provided.

The rational category of causes includes:

- Signs of a satisfactory technical condition (low value of physical depreciation) of the main structural elements,

- Features of space-planning solutions that allow implementing the modernization of the original (production) function or provide conditions for a new function of production and/or non-production type,

- The level of necessary technical and economic costs for reconstruction (modernization) of the facility for production (compared with the object of new construction),

- The status of "object of cultural and historical heritage", and

- Possible attraction of additional investment in the development of an urban situation (urban dominants around the existing production facility or the facility itself) by forming new architectural objects of various functional purposes.

The emotional category of causes includes:

- Danger of loss of town-planning appearance and historical memory of the corresponding building,

- Possible loss of the existing harmony and ways of visual interaction with the surrounding artificial and natural landscape, and

- Threats to increase the environmental burden on the environment due to the dismantling of the existing construction site and new construction.

However, the needs for making qualitative changes in the existing urban conditions and a certain shortage of free urban space for development determine the main directions and conditions for adaptation and re-profiling of the industrial facilities in the structure of the urban environment.

Results and Analysis

Monitoring the established technological process implementation and resolving the technological discipline violations at the construction site are of high importance. All requirements and instructions have been provided in the documentation during its development and a high-quality implementation of the entire industrial facility redeployment complex has been presented; thus, violation of any requirement of an operation may adversely affect subsequent operations and final quality of the work.

It is widely accepted that control is a check of the actual value of any indicator or the value of its deviation from the established norm. Standardized and non-standardized indicators are subject to control. In fact, standardized indicators are the indicators the norm is set against. Non-standardized indicators are indicators the norm is not set against. Therefore, controlling the standardized indicators means to receive information about the actual state of indicators and its comparison with the established norm, while controlling the non-standardized indicators refers to the determination of their actual value (Lapidus and Topchiy, 2019).

As mentioned, control means to obtain information to manage a technological process in operational terms, assess the labor, prepare technical and accounting reports, and conduct analysis during the production planning. When organizing a control, the requirements for its results are necessary (necessity, sufficiency, reliability, expressivity, and efficiency). Thus, the control elements are present not only directly during industrial facility redeployment but also in the field of management company organization and process management.

Hence, the existing scientific and regulatory documentation research and coefficients with the greatest impact on the quality control have been determined in order to compile a mathematical model of the control degree at a future industrial redeployment facility. It is notable that the coefficients are categorized into two groups of general quality implementation coefficients and coefficients specific only to redeployment (Meneyluk and Lobakova, 2016).

It has been found that organization of territorial and spatial distribution of the main functional processes of the modern post-industrial settlement system (cities and agglomerations) is multifactorial and complex in most cases. The modern urban structure (as a special form of displaying the material and spatial environment) functions in the format of an integral social and industrial complex and constitutes (together with engineering, transport, landscape, and environmental frameworks) a single object of the urban design.

The most frequent phenomenon is the presence of such a town-planning situation that is formed in some local part of the urban system conditions to ensure the state and/or sustainable development of one dominant function (the corresponding territorial zone is characterized as monofunctional) (Abid et al., 2019).

The main features and sequence of the formation of functional-territorial organization of the structure of the urban environment of the modern (post-industrial) settlement system (city, urban agglomeration, and metropolis) are provided below:

- At the initial stage, the urban structure, the formation of the structure of the industrial zone (industrial workplaces, various economic, and industrial purposes) has been formed.

- At the main stage, functional and territorial structure of the settlement system has been expanded by ensuring the established scale, capacity of industrial production, and the phased organization of the residential areas intended for the residence of working personnel who ensured performance of the production processes. The most common format of building a residential area (array) has been located in the peripheral zone of the urban environment;

- At the final stage, social infrastructure (including transport infrastructure and engineering communications necessary to ensure the processes of life) has been formed.

The production part (functional-territorial zone) of the urban environment has been represented by the objects integrated into a hierarchically ordered, multi-level system (Figure 2).

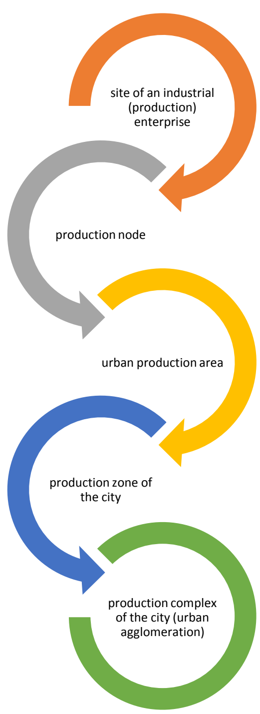

Figure 2: Organizational and technical measures for re-profiling the urban environment

Moreover, it has been found that composition and hierarchy of the subordination of the structural elements forming the industrial environment depended on the specific climatic, urban planning, and large-scale technological features of industrial production and functional relationships with the space of the urban environment.

Therefore, industrial sites and zones included in the urban structure could be considered as centers of gravity, and urban elements of a special composite value (composite centers and dominant) have been interconnected with other functional areas (primarily residential environment) of the relevant spatial and communications links (open spaces, road network, and utility networks).

The effective organization of the use of territory of an urban environment, which is suitable and accessible for building construction facilities for industrial purposes is an urgent task for existing, new, and reconstructed industrial zones. The use of the urban environment to place the production facilities has been directly related to the characteristics of a particular type of industrial industry, the scale of the need for production activities, and permissible level of negative impact on the environment.

However, requirements of developing some branches of management (real economy of the industrial period) led to necessity of formation of such systems of resettlement, in which the structure and functioning of industrial zones have acquired the importance of the main city-forming factor, to which the structure and functionally-territorial balance of the territory available for building have been put in hierarchical subordination.

In addition, a significant share of industrial zones in the balance of functional saturation of the territory of the urban structure clearly indicated an obligation to include the industrial zone in the composition and architectural planning decisions (on the organization of space and connections with other functional zones) of a single and integral urban environment. This circumstance has been equally relevant for reorganization and development of the existing settlement system, as well as the development of new and accessible areas for urban development.

Moreover, typological structure (scientific method of research, which is used for comparative analysis of key features of industrial facilities) allowed solving problems related to the definition of trends in the Genesis and Prospects of improving both types of industrial formations; that is, the newly designed and existing facilities-with the use of appropriate logical forms (Figure 3).

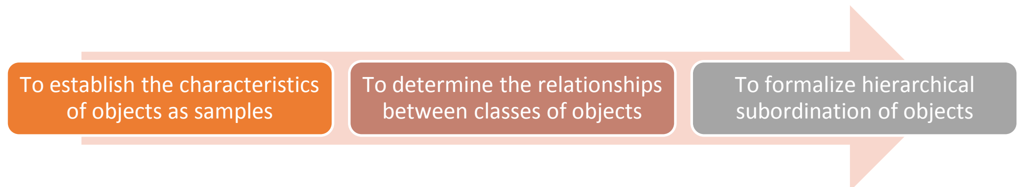

Figure 3: The main directions for the implementation of projects of conversion

The Genesis of the production function (space) has been formed under the influence of urban planning, social, and economic factors. Urban factors (functional purpose, location, density, and capital of the building) characterized the composition and scale of the industrial environment (space).

Conclusiones

A distinctive feature of the life cycle of such objects is the possibility of further operation after hardware upgrade or conversion, which in turn can be carried out in the form of renovation of existing buildings and remediation of soil surrounding space, and a full dismantling of buildings and construction of residential and social facilities.

This study showed the structure of the main and possible periods of the life cycle of construction objects of industrial purpose. Then, the study defined the structure of groups of factors of influence leading to decrease in functional efficiency (loss of quality) of construction objects of industrial appointment. Repurposing of the production facilities refers to a possible stage (period) of the life cycle.

Moreover, characteristic features of constructive decisions (both standard and unique) of industrial formations (objects and territories) have been given as a part of structure of the city environment of modern (postindustrial) systems of resettlement.

It has been established that the decreased quality of the construction products (the state of construction facilities for industrial purposes) could result in an increase in the environmental and socio-economic burden on other elements of the urban area (artificial environment) and/or the surrounding natural landscape (natural environment).

In addition, the study developed the methodological bases of strategy of development of industrial formations and reorganization of industrial zones of the city environment. Then, it addressed the main directions (concepts) of development and transformation of the initial production function of urban environment objects.

It is notable that restoration of the quality of industrial formations (objects and territories of the urban environment) lost in the process of functioning (operation) would be a complex task, the solution of which contributes to the rational development of sites and zones of urban space.

Furthermore, the concept and features of information support of organizational and technological decisions at the re-profiling of production facilities have been considered in the study. Finally, it has been found that information support is becoming one of the significant resources determining the quality of the formation of construction production.

References

Abid, N.M., Saeed, A.A., Al-Beyaty, S.F.G. (2019). Trends in the Physical and Social Urban Form: Policy-Making and Natural Sustainable Development Dialectics. Journal of Southwest Jiaotong University, 54(6). http://jsju.org/index.php/journal/article/view/460

Abramov, I. (2019). Formation of integrated structural units using the systematic and integrated method when implementing high-rise construction projects. HRC 2017 (HIGH-RISE CONSTRUCTION-2017) E3S Web of Conferences, 2018, 33, 1-7.

Abramov, I., Poznakhirko, T., Sergeev, A. (2016). The analysis of the functionality of modern systems, methods and scheduling tools. MATEC Web Conf, 86, 1-5.

Ginzburg, A. (2016). Sustainable building life cycle design. MATEC Web of Conferences. XV International conference «Topical problems of architecture, civil engineering, energy efficiency and ecology», 02018.

Graham, P. (2003). Building Ecology: First Principles For A Sustainable Built Environment. Blackwell Science, 76.

Lapidus, A. (2014). Integral potential effectiveness of organizational and technological and managerial decisions of building object. Applied Mechanics and Materials, 584-586, 2230-2232.

Lapidus, A., Abramov, I. (2018). Formation of production structural units within a construction company using the systemic integrated method when implementing high-rise development projects. E3S Web of Conferences, 33.

Lapidus, A., Topchiy, D. (2019). Formation of Methods for Assessing the Effectiveness of Industrial Areas' Renovation Projects. Proceedings of the IOP Conference Series: Materials Science and Engineering, 471, 1-6.

Lapidus, A.A., Govorukha, P.A. (2015). Organizational and technologic potential of setting of enclosing structures for residential buildings. International Journal of Applied Engineering Research, 10(20), 40946-40949.

Meneyluk, A.I., Lobakova, L.V. (2016). Methodology for choosing effective models for the implementation of buildings reprofiling projects. Bulletin of the Kharkov National Technical University. Series: Management Strategy, Portfolio Management, Programs and Projects, 1, 76-81.

Newton, S. (2016). The Being of Construction Management Expertise. Construction Management and Economics, 34, 7–8.

Oleynik, P., Sinenko, S., Zhadanovsky, B., Brodsky, V., Kuzhin, M. (2016). Construction of a complex object. MATEC Web of Conferences. 5th International Scientific Conference «Integration, Partnership and Innovation in Construction Science and Education», 4059.

Pezeshki, Z., Ivari, S.A.S. (2018). Applications of BIM: A Brief Review and Future Outline. Archives of Computational Methods in Engineering, 25(2), 273–312.

Pukhkal, V.A., Mottaeva, A.B. (2018). FEM modeling of external walls made of autoclaved aerated concrete blocks. Magazine of Civil Engineering, 81(5), 203-212.

Roodman, D.M., Lenssen, N.K., Peterson, J.A. (1991). A Building Revolution: How Ecology and Health Concerns Are Transforming Construction. WorldwatchInst, 67.

Shinri, S., Masamichi, T. (n.d.). Developing environmental load factors for construction materials used in social infrastructure LCA. Enviromental System Research Papers, 38, 185-191.

Surya, B., Saleh, H., Syafri, Ahmad, D.N.A. (2019). Impact and Sustainability of New Urban Area Development in Moncongloe-Pattalassang, Mamminasata Metropolitan. Journal of Southwest Jiaotong University, 54(6). http://jsju.org/index.php/journal/article/view/462

Topchiy, D., Yurgaitis, A., Kravchuk, A., Shevchuk, D. (2019). Controlling methods of buildings' energy performance characteristics. Topical Problems of Architecture, Civil Engineering and Environmental Economics (TPACEE 2018) electronic edition. E3S Web of Conferences.

Volkov, A., Chulkov, V., Kazaryan, R., Fachratov, M., Kyzina, O., Gazaryan, R. (2014). Components and guidance for constructional rearrangement of buildings and structures within reorganization cycles. Applied Mechanics and Materials, 2281-2284.

Volkov, A., Sedova, A., Chelyshkov, P., Titarenko, B., Malyha, G., Krylov, E. (2016). The theory of probabilities methods in the scenario simulation of buildings and construction operation. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 7(3), 2416-2420.

Zhadanovsky, B.V., Sinenko, S.A. (2014). Visualization of design, organization of construction and technological solutions. Computing in Civil and Building Engineering. Proceedings 2014 International Conference, 137-142.

Zueva, D.D., Babushkin, E.S., Topchiy, D.V., Yurgaitis, A.Yu. (2019). Construction supervision during capital construction, reconstruction and re-profiling. MATEC Web of Conferences, 265, 1-8.