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# APPLICATION OF THE COMBINED APPROACH IN THE ORGANIZATION OF CONSTRUCTION FOR STRUCTURING AND SUBSTANTIATION OF A CYCLE OF DIFFICULT INFRASTRUCTURE PROJECTS

The research hypothesis is based on the assumption that in the context of the digital construction space, it is necessary to create an industry-wide digital platform that automates all stages and procedures of the construction project life cycle, as well as developing a scientific and methodological approach and practical recommendations will allow significantly reduce construction costs and strengthen its competitive position in today's dynamic environment.

It is substantiated that the digital space of the construction industry (construction projects, construction organizations-participants) in the development of information and communication technologies acquires the features of alternative construction business, which should function in a certain transformed environment of construction development projects. Technologies directly related to design and construction (BIM, augmented reality, laser scanning, etc.) increase the efficiency of investment and construction projects, while digital data analysis systems contribute to a better understanding of construction market trends.

The operating system is determined by the introduction of fundamentally new updated scientific and applied tools designed to provide the development company with a clear formalization and proper analytical support of the processes of formation, analysis, and productive subsequent administration: the leading innovation of the tools introduced commercial housing construction, which are implemented in a complex economic and managerial format – production-technological, resource-logistical and administrative management of the content of business processes of project cycles as part of the portfolio of housing construction projects of the developer.

Key words: construction enterprise; life cycle of construction project; level of competitiveness; transformation of business environment; BIM-technology; digital control technologies.

**Statement of the problem.** Large-scale implementation of digital technologies in the activities of the organization as a whole and its management in particular, is a necessary requirement today. One of the ways to achieve high business productivity, transparent activities and maintain competitive advantage is the introduction and effective use of digitalization of the enterprise. Digital technologies, which have emerged over the last decade, are a source of efficiency and opportunities for rapid innovative development of enterprises. At the same time, they require changing existing management models, reformatting communications, technology and organizational structure of enterprises based on new values, priorities and targets based on partnership, customer focus, innovation and synergy.

Digital technologies are playing an increasing role in the management of a business organization and have found application in such aspects as: "digital staff", "digital work" and "digital management". In a dynamic market environment, the digital transformation of construction companies is due to advanced technologies BIM - Building Information, BigData, Artificial Intelligence (AI). They are aimed at processing information flows, which reduces uncertainty in the implementation of investment projects, increases their security, models and predicts the potential effects of various factors at all stages of construction, improves the quality of controlling and cost engineering and more.

**Analysis of recent studies and publications.** Construction projects delivery was characterized by [1–3] as a complex process taking place in a turbulent environment with un- predictable work patterns, especial work and temporarily organized teams. In addition, the construction industry is characterized by limited resources and a high level of competition. Limited re- sources and a competitive environment determine knowledge and information as a particularly important resource for the development of the construction industry.

After the concept of knowledge management was first applied in construction projects, scientists began a discussion on how to manage knowledge and information in specific projects, taking into account the problems associated with the specifics of the construction industry. A significant part of the work was aimed at the analysis of knowledge management in one organization, in which knowledge is considered as a valuable resource or intellectual asset [4-6]. A study of knowledge management between project participants will provide researchers with an improved understanding of the processes and will further improve the construction projects efficiency. Recently, the integration of the general knowledge of participants in a construction project has been gaining importance.

The integration of knowledge is a process in which people who have previously gained experience in specialized fields of knowledge share it in order to achieve a common result. The knowledge integration brings together project participants and

can mitigate the short comings that arise due to the fragmentation of the construction project stages. The knowledge integration between organizations involved in the [6–8] supposed that a joint project team can be very effective, as team members from different organizations create a pool of different skills and knowledge. [9] indicated that when managing a construction project, not only material resources and information should be integrated, but also the knowledge and participants experience. [10] also studied topical issues construction project integration and came to the conclusion that the knowledge in the project is as important as the is- sues of communication and information exchange.

Later, they discovered an anomaly in communication between the participants and proposed an optimization method to increase the effectiveness of using network communication [11-14].

**Formulation of goals.** The aim of the work is a number of complex and urgent scientific-methodological and practical problems appear on the agenda: how to reconcile the vector of renewal of operational activities of construction companies (project executors): with the challenges and benefits of digital economy, modern management technologies and advanced economic and analytical tools (methods and models) justification of decisions construction market share.

**Relevance and novelty.** The effectiveness of the integration process largely depends on how effectively the various forms of interaction between construction companies. In conditions when the interaction of enterprises within integrated structures does not bring the desired effects, there is a growing need to update methodological approaches that improve the management mechanism of integrated structures. One of the conditions for effective knowledge management in the project is the creation and productive operation of a communication system that unites the participants of the project. Communication is a key basis for creating a knowledge base of the project, which includes interaction between participants and ensures the free movement of information between them.

Graph-analytical and digital space and organizational-technological modeling of the construction development project cycle have been developed and substantiated. In contrast to the traditional use of BIM technologies in this paper, BIM and related digital technologies are used together to present a holistic model of the life cycle of a construction development project. At the same time, the structuring of stages and works in construction projects is carried out not by technological content and sections of design and estimate documentation, but by consolidated sets of works given to a certain organization and regulated by relevant tripartite "subcontract agreements" between customer, developer and contractor. The model is implemented in a multidimensional analytical space, which is implemented artificially integrated "synthetic" BIM-network, which combines the features of the BIM-model with

decision-making tools based on "geometric econometrics". A constructive element of the created model is a BIM-description, which includes: visual-graphic model of a part of the object (buildings or structures), which is the object of activity of a certain subcontractor; grapho-morphological fragment of the element-work as part of the integrated cycle model; an array of organizational-technological and administrative-managerial parameters, some of which are strictly determined (normative), and the rest are adjusted

There is a problem of “explosive” growth in the number of management points in an instance of a business process. It is necessary to consider the results of modeling the most popular elements of business processes in accordance with the international standard UML for the subsequent presentation of the problem.

Figure 1 shows a graphical representation of node “Action” for executable business processes. Such node is indicated by a rounded rectangle, in the centre of which the name of the node is written. Figure 1 shows a graphical representation of route node “Branching”. Such a node should have one incoming and several outgoing transitions. In this node, for each control point that arrives at it, a choice is made according to which of the outgoing transitions it will be transmitted further. It is designated by a rhombus.

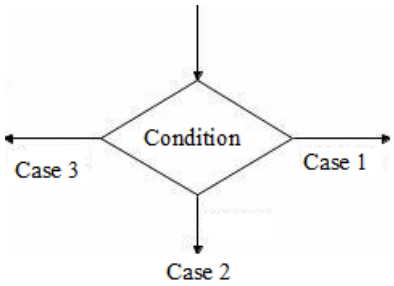


Fig.1.Graphical representation of business processes node “Branching”

Figure 2 shows a graphical representation of route node “Compound”. Such a node should have several incoming and one outgoing transition. In this node, all control points that came to it are sent along the outgoing transition. It is designated by a rhombus.

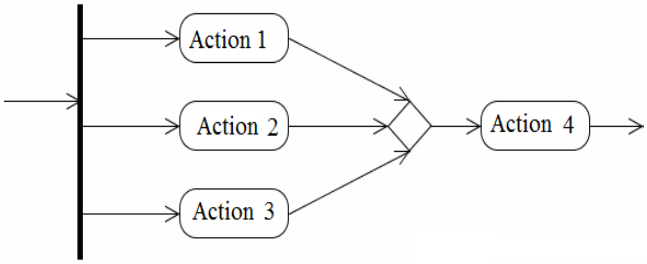


Fig.2.Graphical representation of business processes node “Compound”

Thus, indicators of external influence affecting the innovative business entity of the con-struction industry are:

1. competition;
2. demand for finished products in the industry;
3. the average level of capacity utilization in the industry;
4. level of state support;
5. the level of socio-economic development of the region;
6. the economic situation in general in the construction industry;
7. level of entrepreneurial confidence in the construction industry [1-4].

In turn, the indicators of the internal environment of the enterprise, which affects its inno-vation potential, include:

1) social:
- the level of involvement of employees of the organization;
- timeliness of payment of wages;

2) organizational and managerial:
- the share of employees involved in innovative projects from the total number of manage-ment staff;
- frequency of marketing research;

3) production and economic:
- the share of intangible assets in the total cost of fixed capital;
- participation in contract bidding;
- execution of the order on commissioning of objects;
- the volume of execution of the construction and installation work under the agreement(contract);
- labor productivity per employee, thousand UAH/day;
- level of profitability;
- financial stability;
- customer satisfaction;
- deviations in terms of construction duration;
- uniformity of construction;
- application of effective methods of organization and technology of construction produc-tion;
- provision of labor resources;
- provision of building materials and structures;
- level of specialization of the construction organization.

4) technological:
- level of automation of construction processes;
- quality of construction works;
- compliance with the rules of TV and labor protection;
- quality of design and estimate documentation;
- share of highly qualified personnel.

The use of BIM technology allows the introduction of new standards of production and management in construction, namely the introduction of the concept of integrated implementation of the construction project (Integrated Project Delivery, IPD).

IPD is a project approach that brings together people, organizations, business structures and practical experience in a process that shares the knowledge and ideas of all project participants to optimize results, increase value, reduce waste and maximize efficiency for all. stages of planning, design and construction.

The integrated process is characterized by:

- early stakeholder participation. The principle is to involve stakeholders, including the designer, contractor, designers and contractors from the very beginning of the project.
- overall risk and rewards. Project participants share both possible risks and rewards from project implementation.
- joint decision-making and control. Based on the owner's goals, the project parties formulate a clear and specific set of criteria for decision-making and project control.
- jointly developed and approved project objectives. With the help of stakeholders, the owner clearly defines achievable goals and benchmarks for measuring them.

High level of trust between project team members. Trust is the basis for effective integration of participants in the construction project, is an effective way to minimize problems of interaction, improve communication and, accordingly, increase the success of the project. The presence of trust unites the key participants of the project, and the lack of trust destroys it. It is advisable to use cognitive trust cards to assess the level of trust between project participants.

Barriers to the use of BIM and IPD technologies:

- fear of insignificant effect or no effect at all;
- high initial investment costs;
- he time needed to study the software;
- unregulated regulatory framework for the status of information modeling and its implementation in the construction process at all stages;
- unwillingness of investors to bear additional costs for information models that can be used not only in construction but also in the operation of facilities;
- inertia and traditional construction industry, insufficient understanding of the benefits of BIM.

Lack of standardized business and contract models in construction, to which the end-to-end BIM process could be “tied”. To identify the key elements of communication networks, it is important to know the structural significance of all

network participants and the connections between them. The paper analyzes the existing approaches to determining the measures of centrality of communication network nodes, which give a better understanding of the participant's place in the network and the level of its importance and impact.

The optimality of the decisions made significantly depends on the effectiveness of the communication process, which in turn depends on the organizational structure of the project and information links. Three main types of *network organizational structure* (NOS) that can be used by enterprises in the implementation of the project in construction were considered: focal, dynamic and multifocal.

The NOS focal type scheme assumes that all decisions are made in consultation with the network manager. The efficiency of the focal type NOS is determined by the ratio:

$$F = k_1 \times F_0, \quad (1)$$

where $F_0$ is the potential efficiency of the MOS, which is determined only by its structural scheme;

$k_1$ is the coverage factor, which determines the ratio of the number of completed and completed communications l to the total number of requests $n$ $(k_1 = l/n)$.

The scheme of the dynamic type of NOS provides that each participant must agree on its proposal with all other participants in the network. The efficiency of such a scheme is determined by the expression:

$$F = k_2 \times F_0, \quad (2)$$

where $k_2$ - overload factor takes into account the reduced efficiency of workers who are forced to combine their production responsibilities with intensive communication activities. Its value can be taken as $n$ $(k_1 = l/n)$.

Since integration is a process in which two or more participants can be involved, the assessment of the effect should be given from the standpoint of the overall result, the embodiment of which is a synergistic effect.

**Conclusion.** Information modeling in construction can be an important tool for analyzing large data sets (Big Data) and generating information and knowledge that is formed at each stage of the construction project. With the active development of the concept of big data, some traditional methods and models need to change. In particular, the concept of knowledge management, based on a relatively small number of them, does not always cope with the processing, analysis and acquisition of knowledge with a significant increase in input. Accumulated large data sets can be a corporate asset, the use of which allows you to make better forecasts and make the right informed decisions. In addition, the knowledge gained in the project and tested

in practice can be considered more reliable than the data of experiments or simulations, because they contain more basic knowledge of reality.

Thus, the analysis, structuring and solution of methodological and conceptual problems of modeling the dynamics of innovation strategies for digitization of construction management system allows to reach a qualitatively new level of formalized procedures and methods for modeling the dynamics of innovation at the micro level.

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## ЗАСТОСУВАННЯ КОМБІНОВАНОГО ПІДХОДУ В ОРГАНІЗАЦІЇ БУДІВНИЦТВА ДЛЯ СТРУКТУРИЗАЦІЇ ТА ОБГРУНТУВАННЯ ЦИКЛУ СКЛАДНИХ ІНФРАСТРУКТУРНИХ ПРОЕКТІВ

Гіпотеза дослідження ґрунтується на припущенні, що в контексті цифрового будівельного простору необхідно створити галузеву цифрову платформу, яка автоматизує етапи та процедури життєвого циклу будівельного проекту, а також розробити науково-методичний підхід і практичні рекомендації, які дозволять істотно знизити витрати на будівництво та зміцнити його конкурентні позиції в сучасних динамічних умовах.

Обґрунтовано, що цифровий простір будівельної галузі (будівельні проекти, будівельні організації-учасники) у розвитку інформаційно-комунікаційних технологій набуває ознак альтернативного будівельного бізнесу, який має функціонувати в певному трансформованому середовищі проектів розвитку будівництва. Технології, безпосередньо пов’язані з проектуванням і будівництвом (BIM, доповнена реальність, лазерне сканування тощо), підвищують ефективність інвестиційних та будівельних проектів, а цифрові системи аналізу даних сприяють кращому розумінню тенденцій будівельного ринку.

Операційна система визначається впровадженням принципово нових оновлених науково-прикладних засобів, призначених для забезпечення компанії-розробника чіткої формалізації та належного аналітичного супроводу процесів формування, аналізу та продуктивного подальшого адміністрування, що є провідною інновацією впроваджених інструментів комерційне житлове будівництво, які реалізуються в комплексному економіко-управлінському форматі: виробничо-технологічному, ресурсно-логістичному та адміністративному управлінні змістом бізнес-процесів проектних циклів у складі портфеля проектів житлового будівництва забудовника.

Ключові слова: будівельне підприємство; життєвий цикл будівельного проекту; рівень конкурентоспроможності; трансформація бізнес-середовища; BIM-технологія; цифрові технології управління.

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## ПРИМЕНЕНИЕ КОМБИНИРОВАННОГО ПОДХОДА В ОРГАНИЗАЦИИ СТРОИТЕЛЬСТВА ДЛЯ СТРУКТУРИЗАЦИИ И ОБОСНОВАНИЯ ЦИКЛА СОСТАВЛЯЮЩИХ ИНФРАСТРУКТУРНЫХ ПРОЕКТОВ

Гипотеза исследования основывается на предположении, что в контексте цифрового строительного пространства необходимо создать отраслевую цифровую платформу, которая автоматизирует этапы и процедуры жизненного цикла строительного проекта, а также разработать научно методический подход и практические рекомендации, которые позволят существенно снизить затраты на строительство и укрепить его конкурентные. позиции в современных динамических условиях

Обосновано, что цифровое пространство строительной отрасли (строительные проекты, строительные организации-участники) в развитии информационно-коммуникационных технологий приобретает признаки альтернативного строительного бизнеса, который должен функционировать в определенной трансформированной среде проектов развития строительства. Технологии, напрямую связанные с проектированием и строительством (BIM, дополненная реальность, лазерное сканирование и т.п.), повышают эффективность инвестиционных и строительных проектов, а цифровые системы анализа данных способствуют лучшему пониманию тенденций строительного рынка.

Операционная система определяется внедрением принципиально новых обновленных научно-прикладных средств, предназначенных для обеспечения компании-разработчика четкой формализации и надлежащего аналитического сопровождения процессов формирования, анализа и продуктивного дальнейшего администрирования, являющегося ведущей инновацией внедренных инструментов коммерческого жилищного строительства, реализуемых в комплексном экономико-управленческом формате: производственно-технологическом, ресурсно-логистическом и административном управлении содержанием бизнес-процессов проектных циклов в составе портфеля проектов жилищного строительства застройщика.

Ключевые слова: строительное предприятие; жизненный цикл

строительного проекта; уровень конкурентоспособности; трансформация бизнес-среды; BIM-технология; цифровые технологии управления.

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