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ASSESSMENT OF ECONOMIC EFFICIENCY OF CONSTRUCTION ORGANIZATION AND WORK EXECUTION PROJECTS

The article discusses current approaches to assessing the economic efficiency of organizational and technological decisions made in the implementation of construction projects. The authors propose to use a system of indicators that reflect the impact of rationalization of design solutions on the cost, scope of work and the need for fixed and working capital. Particular attention is paid to the variant design of the organization of construction, taking into account the different duration and financial capabilities of construction organizations. It is emphasized that when comparing work production plans (PPR), the one that provides minimum costs and rational use of resources while maintaining the construction time is economically preferable. Thus, the effectiveness of the decisions made is evaluated through an increase in profit due to an increase in the volume of work performed and a reduction in costs. The work also highlights the gaps in the development of the theoretical foundations of production process management in construction and emphasizes the importance of lean construction concepts as a promising area of research.

Keywords: economic efficiency, construction organization, organizational decisions, reduced costs, construction duration, cost price, fixed assets, working capital.

Introduction

The economic efficiency of the organization of production processes in the construction industry is determined by the cumulative impact of many factors related to both the internal and external environment of the functioning of enterprises. Modern construction production is a complex system that includes many interrelated structural elements that function in conditions of broad cooperation with various participants in the investment and construction process.

In the context of growing competition and the need to increase the effectiveness of capital investments, rational design and management of organizational and technological solutions is of particular importance. The efficiency of construction enterprises depends not only on the optimal implementation of the main production process, but also on the well-coordinated work of auxiliary and service departments that ensure the achievement of common goals and the output of final products.

Thus, the study of the issues of assessing and increasing economic efficiency in construction is an important area of scientific research aimed at improving the processes of planning, organizing and managing production resources within the framework of construction projects.

Literature review

The modern practice of management of construction production faces a number of systemic problems associated with the limitation or obsolescence of the models and methods used. As the research of Koskela and his co-authors shows, existing management approaches in the construction industry often ignore the variability of processes and the flow nature of activities, focusing primarily on productivity as a static quantity. This leads to a lack of flexibility and a decrease in the accuracy of management decisions in the context of high dynamics of construction projects.

Allen, Lu, Kroom-Clements et al. emphasize the need to develop and implement a scientifically based theoretical framework that reflects the real characteristics of the construction sector. Since the early 1960s, there has been a bias towards quantitative modeling and economic theories in the management of production processes, which has influenced the entire paradigm of management in construction. However, as Simon notes, effective management requires not only the analysis of isolated elements, but also an understanding of their interrelationships and functional feasibility.

The work of Buffet et al. indicates that overspecialization and reductionism in modeling has led to a large amount of irrelevant and unreliable research. These studies often do not reflect the real cause-and-effect relationships in building production systems, which is especially critical in the environment.

Lu et al. emphasize that the planning and management models used in construction are focused on abstracting and simplifying processes. The dominant conversion model of Koskela, being borrowed from classical production systems, does not take into account the flow component of construction processes and does not reflect the real structure of construction activities.

These limitations encourage the development of new approaches based on clear scientific theories. According to Rooke et al., a theory should describe reality by identifying key phenomena and excluding secondary ones, while Popper emphasizes the need to formalize postulates that can be verified. However, in the context of construction production, such postulates are often either absent or based on the adaptation of philosophies borrowed from other industries.

Thus, in the construction industry there is an objective need to develop a specific, scientifically based theory of production management and capable of increasing the efficiency of decision-making and project management.

Materials and methods

A modern system for analyzing the quality of organizational and technological decisions made, for example, at the level of a construction management project (CMP), should be based on the use of a number of indicators:

– economic efficiency as a result of optimization of present costs due to the saving of all production resources (E);

– rational optimization of the estimated cost of construction and installation works (ΔCcm);

– indicator of expected profit growth as a result of a decrease in the cost of construction and installation works);

– projected terms of reduction in the duration of construction production;

– the economic effect of rationalizing the use of labor resources;

– natural and cost indicators of optimization of the use of material resources;

– dynamics of capital intensity of construction production [1, P. 136; 2, P. 418].

It is recommended to analyze the expected economic effect from the optimization of the PIC using the following formula:

$$Э = \left[\sum_{i=1}^{T_1} З_{1i} \times \alpha_{ti} - \sum_{i=1}^{T_2} З_{2i} \times \alpha_{ti} \right] \pm Э_T,$$

where S1i and S2*i* are the values of present costs for alternative project options;

T1 and T2 are the expected duration of construction work according to the comparison options;

αti is the cost reduction factor by year of project implementation;

ET is the value of the economic efficiency of the project, due to the reduction of the duration of work.

If the optimization of the PIC (for example, the introduction of a nodal method of design, preparation, organization and management of the project) provides a reduction in the cost of its development, it is recommended to take into account the changes in the corresponding costs of the ΔCpr:

$$\Delta C_{пр} = З_{п} \times (N_1 \times t_1 - N_2 \times t_2) + (\Theta_1 - \Theta_2),$$

where Salary is the cost of remuneration of one employee of the design organization during the month, ten./person. x months;

N1 and N2 are the average number of PIC developers involved in variant design, people;

t1 and t2 are the duration of PIC development for alternative projects, months;

Θ_1 and Θ_2 are the costs of variant design associated with the use of computer and other office equipment, ten.

It is recommended to calculate the volume of investment resources in the structure of fixed production assets (OPF) of the construction company K, as a component of present costs, using the following formula:

$$К = Ф \times М_{о} / М_{п},$$

where F is the volume of funds of the construction enterprise, including machinery and equipment, ten.;

MP and MO are the planned standard of machine shifts and the number of machine shifts of equipment operation, according to the PIC [3, P. 236–239].

If the project provides for a change in the need for construction in working capital, this should be taken into account in the calculations. The amount of these investments Co (as a percentage of the estimated cost of construction and installation works) should be taken into account as part of the present costs:

$$З_{i} = С_{i} + Е_{н} \times (К_{i} - К_{о}).$$

Expected changes in the estimated cost of construction and installation works in the case of variant design of their organization should be calculated taking into account all limiting costs in accordance with the approved standards:

$$\Delta C_{см} = \frac{(C_{см1} - C_{см2}) \times (100 + n)}{100}$$

where Cм1 and Cм2 are the estimated cost of alternative options for organizing construction and installation works, including overhead costs and planned savings, ten.;p is the coefficient of increase in the cost of work in winter, as well as due to various unforeseen works and costs, % [4, P. 136–138].

The economic effect of EV due to the use of temporary inventory buildings of mobile and container type in comparison with similar buildings of the traditional type should be calculated according to the formula:

$$Э_в = \left(З_1^{/} + З_{с1}\right) \times \varphi + \frac{И_1 - И_2}{Р_2 + Е_н} - З_2 \times Т \times Р_2,$$

where $З_1^{/}$ are the material costs for temporary buildings at the construction site;

3c1 – costs for the design and construction of temporary buildings and structures as part of the PIC;

φ is the coefficient of increase in the service life of a mobile inventory building in comparison with a traditional one;

P1 and P2 are the shares of annual expenditures on temporary buildings and structures under the traditional and mobile inventory options;

I1 and I2 – projected costs of operation of temporary buildings and structures in the case of variant development of the PIC;

32 – the amount of present costs for the manufacture and delivery of mobile inventory buildings and structures to the construction site;

T is the design service life of mobile inventory buildings and structures;

En is the standard value of the coefficient of economic efficiency of capital investments [5, P. 318–320].

The economic efficiency of the variant development of the PIC, taking into account changes in the duration of construction and the cost of fixed production assets in the structure of present costs, should be calculated according to the formula:

$$Э = \sum_{i=1}^{T} 0{,}12 \times (C_i^{//} - C_i^{/}) + (Э_н + Э_д + Э_р) - Д,$$

where E is the projected economic efficiency;

T is the maximum duration of construction in the case of variant development of the PIC;

0.12 – coefficient reflecting the standard value of efficiency in the construction industry;

$C_i^{/}; C_i^{//}$ – expected values of the average annual cost of legal forms by years of construction under the design option;

En is the projected effect due to the reduction of the amount of conditionally fixed overhead costs;

Ed is the possible effect arising from the early commissioning of the OPF of the enterprise under construction;

Er is an additional effect associated with more rational planning of capital investments;

D is the projected additional costs due to the reduction of construction time [6, P. 221–223].

Results and discussion

According to a number of researchers, it is advisable to calculate the increase in the efficiency of the organization of construction production, due to the reduction of conditionally fixed overhead costs and the early commissioning of the OPF of the industrial enterprise under construction, according to the formulas:

$$Э_н = H \times (1 - T_2 / T_1),$$
$$Э_д = 0{,}12Ф \times (T_1 - T_2),$$

where N is the sum of conditionally fixed overhead costs;

T1 is the standard construction period;

T2 is the alternative duration of construction in the case of a variant design of the construction site;

F is the projected estimated cost of the commissioned legal forms [7, P. 63–65].

In the case of variant design of the organization of construction production, including various scenarios for the distribution of capital investments over the corresponding accounting periods, the expected effect can be determined by the formula:

$$Э_р = 0{,}12 \times (K_1 T_1 - K_2 T_2),$$

where K1; K2 are the average values of capital investments for the basic and alternative options;

T1, T2 are the projected dates of completion of construction according to alternative options [8, P. 269–271].

In the system of analysis of the economic efficiency of the work production plan (PPR), it is advisable to use the following main indicators:

expected effect as a result of optimization of present costs E;

projected increase in the volume of work performed ΔA;

the expected increase in the profit of the construction company ΔP [9, P. 84–88].

The calculation of economic efficiency due to the choice of the most rational organizational and technological solutions at the stage of development of PPR should be carried out using the formula:

$$Э = (З_1 - З_2) + Э_m.$$

In general, the effect of reducing the construction time of a particular facility is determined by comparing it with the duration adopted in the relevant PIC. A possible basis for calculating the effectiveness of PPR for this indicator can be similar projects or current standard values [10, P. 116-119].

It is recommended to determine the economic efficiency of the PPR developed as a detailed PIC for individual facilities taking into account the increase in profit ΔP received as a result of an increase in the annual volume of work performed:

$$\Delta П = \frac{\Delta A \times П_1}{A_1} + Э_y,$$

where ΔA is the change in the amount of work performed within the accounting period;

P1 is the volume of planned savings related to the basic volume of construction and installation works;

A1 is the scope of work planned according to the basic option;

Eu is the expected value of reduction of conditionally fixed costs of a construction organization, which is recommended to be calculated according to the following formula:

$$Э_y = 0{,}01 \times H \times C_{см} \times (\gamma - 1),$$

where N is the projected amount of conditionally fixed costs, expressed as a percentage of the estimated cost of construction and installation works;

Scm is the value of the estimated cost of work corresponding to the basic version of the organization of construction production;

γ is a coefficient that characterizes the increase in the volume of work performed at the facility, defined as the ratio A2 / A1.

At the same time, it is generally recommended to calculate the projected amount of conditionally fixed costs of a construction and installation organization (CMO) N using the following formula:

$$H = (0{,}01 \times q + 0.15 \times m + 0.5 \times n) \times \frac{C_o}{100},$$

where 0.01; 0,15; 0.5 – the corresponding shares of conditionally fixed costs attributable to materials, operation of machines and mechanisms, as well as overhead costs;

q, m, n – the corresponding coefficients in the structure of the cost of work, determining the percentage of costs for materials, operation of machines and mechanisms, as well as for overhead costs;

Co is the value of the cost of construction and installation works according to the basic comparison option.

When performing preliminary approximate calculations, the values of the above-mentioned coefficients q, m, n should be taken within the range of 60, 8, 14 % [11, P. 394–401].

If, in the process of comparative analysis of the economic efficiency of alternative PPRs, the terms of construction of facilities turn out to be the same, it is recommended to consider the cost of work, as well as the amount of investments in fixed and circulating production assets of SMOs as the most important factors for comparison:

$$Э = (C_1 - C_2) + 0{,}12 \times (C_1^{/} - C_2^{/}),$$

where C_1 $C1_2$ is the difference in the cost of work on alternative options;

$C_i^{/}; C_i^{//}$ – the difference in the cost of fixed and circulating assets of the SMO according to alternative options.

Otherwise (when the compared options differ in the duration of work), this circumstance should be taken into account [12, P. 123–126].

In addition, the feasibility analysis and justification of decisions on the organization of construction production must be carried out taking into account the requirements of safety and labor protection.

Conclusion

Thus, when improving the organization of construction production that optimizes costs (for example, as a result of the use of the nodal method of design, preparation, organization and management of construction), these factors of

increasing the economic efficiency of the PIC and PPR should be taken into account.

In the event that the method of construction organization provided for by the project leads to a change in the need for working capital or capital investments in fixed production assets, then these components should also be taken into account, which ensure an increase in the efficiency of construction production.

Savings in the estimated cost of construction in the case of variant design of its organization should be calculated taking into account all limiting costs on the basis of current standards and the consolidated estimate of construction and installation works.

In many cases, it is also recommended to evaluate alternative options for the organization of construction production, taking into account changes in the construction time and the resulting time factor in the formation of economic efficiency.

It is also necessary to take into account the effect of reducing conditionally fixed overhead costs associated with the early commissioning of the main production assets of the facilities under construction.

In general, it is recommended to carry out the economic assessment of the CMP and PPR linked to the production (annual, two-year) programs of the CMO, focusing on the increase in profit received as a result of the growth of the annual volume of work performed.

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ҚҰРЫЛЫС ҰЙЫМДАСТЫРУ ЖӘНЕ ЖҰМЫС ӨНДІРІСІ ЖОБАЛАРЫНЫҢ ЭКОНОМИКАЛЫҚ ТИІМДІЛІГІН БАҒАЛАУ

Мақалада құрылыс саласында қабылданған ұйымдастырушылық және технологиялық шешімдердің экономикалық тиімділігін бағалаудың ағымдағы тетіктерінің сипаттамасы берілген. Құрылысты ұйымдастыру жобаларының (СОР) және жұмыс өндірісі жобаларының (ЖҚ) экономикалық тиімділігін сипаттайтын көрсеткіштердің нақты тізімі ұсынылады. ПОС-ты ұтымды ету (құрылысты жобалау, дайындау, ұйымдастыру және басқару кезінде түйіндік әдісті қолдану) шығындардың өзгеруіне әкелетін жағдайларда бұл жағдайды ескеру қажет. Егер құрылысты ұйымдастыру жобасының өзгеруі нәтижесінде қажетті айналым қаражатының тиісті көлемдері де өзгерсе, бұл оның тиімділігін есептеу кезінде де ескерілуі керек. Құрылыс ұйымының нұсқасын оның әртүрлі ұзақтығын және нақты құрылыс ұйымдарының негізгі өндірістік қорларының құнын ескере отырып жобалау ұсынылады. ПҚР экономикалық тиімділігін бағалау жүйесінде келесі негізгі көрсеткіштерді қолдану қажет: төмендетілген шығындарды оңтайландыру тиімділігі, орындалған жұмыс көлемінің және алынған пайданың өзгеруі. Осылайша, жеке құрылыс объектілері бойынша қабылданған ұйымдық-технологиялық шешімдердің сапасын экономикалық бағалаудың негізі орындалған жұмыстардың жылдық көлемінің өзгеруі нәтижесінде алынған пайданың динамикасын көрсеткіштерді есептеу және бағалау болуы керек. Салыстырылған PPR нұсқалары құрылыс ұзақтығы бойынша ерекшеленбесе, ең үнемді жоба жұмыстың төмен құнымен, сондай-ақ талданатын жобаларды жүзеге асыратын құрылыс компанияларының негізгі және айналым капиталының аз көлемімен сипатталады.

Кілтті сөздер: экономикалық тиімділік, құрылыс ұйымдастыру, ұйымдастыру шешімдері, келтірілген шығындар, құрылыс мерзімі, өзіндік құн, негізгі қорлар, айналым қаражаты.

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ОЦЕНКА ЭКОНОМИЧЕСКОЙ ЭФФЕКТИВНОСТИ ПРОЕКТОВ ОРГАНИЗАЦИИ СТРОИТЕЛЬСТВА И ПРОИЗВОДСТВА РАБОТ

В статье рассматриваются актуальные подходы к оценке экономической эффективности организационно-технологических решений, принимаемых при реализации строительных проектов. Авторы предлагают использовать систему показателей, отражающих влияние рационализации проектных решений на себестоимость, объемы работ и потребность в основных и оборотных средствах. Особое внимание уделено вариантному проектированию организации строительства с учетом различной продолжительности и финансовых возможностей строительных организаций. Подчеркивается, что при сравнении проектов производства работ (ППР) экономически предпочтительным является тот, который обеспечивает минимальные затраты и рациональное использование ресурсов при сохранении сроков строительства. Таким образом, эффективность принимаемых решений оценивается через прирост прибыли за счет увеличения объема выполненных работ и снижения издержек. Работа также освещает пробелы в развитии теоретических основ управления производственными процессами в строительстве и подчеркивает значимость концепций бережливого строительства как перспективного направления исследований.

Ключевые слова: экономическая эффективность, организация строительства, организационные решения, приведенные затраты, срок строительства, себестоимость, основные фонды, оборотные средства

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