

# Utilizing a value-oriented approach to rationalize design, organizational and technical solutions in construction

Anatoliy Trebukhin<sup>1,\*</sup>, Aleaxander Kolosov<sup>2</sup>, and Konstantin Kuzmin<sup>3</sup>

<sup>1</sup>Moscow State University of Civil Engineering, Yaroslavskoye sh., 26, 129337, Moscow, Russia

<sup>2</sup>Voronezh State Technical University, 20-letiya Oktyabrya Street, 84, 394006, Voronezh, Russia

<sup>3</sup> Moscow State University of Technology and Management named after K.G. Razumovsky (Smolensk branch), 77, Lenin str., 215100, Vyazma, Russia

**Abstract.** The purpose of this study is to apply the method of value-oriented management to rationalize the choice of design, organizational and technical solutions, taking into account the current market situation. To solve the identified problems, it is proposed to revise the principles of assessing organizational and technical solutions using project management tools, stakeholder theory and the evolutionary theory of values. As a result, the theoretical foundations and methodological recommendations on the economic justification for the choice of organizational and technical solutions in the implementation of an investment and construction project were considered. The theoretical and methodological basis of the research are the works of scientists and specialists devoted to research in the field of theoretical and general methodological problems of assessing the effectiveness of capital investments in construction, as well as the application of a value-oriented approach in the management of investment and construction projects.

## 1 Introduction

Design, organizational and technical solutions in construction are aimed at choosing progressive and economically feasible options for implementing investment and construction projects (ICP), ensuring reasonable cost savings. Analysis of the theoretical and methodological support for the economic justification for the choice of organizational and technical solutions made it possible to identify a number of problems that require solutions:

1) the current methodology for assessing the economic efficiency of options for organizational and technical solutions, focusing on cost reduction, is not aligned with the demands of modern market conditions.;

2) the methodology for assessing the economic efficiency of investment projects using a system of indicators reflecting the ratio of costs and results allows one to assess the effectiveness of the project as a whole, show the investor the financial feasibility of such a

---

\* Corresponding author: [licence05@list.ru](mailto:licence05@list.ru)

project, and is not used to assess organizational and technical solutions of construction projects;

3) the methodological basis for assessing organizational and technical construction solutions taking into account the current market situation has not been sufficiently studied.

To solve the identified problems, it is proposed to revise the principles of assessing organizational and technical solutions using project management tools, stakeholder theory, and the evolutionary theory of values.

It is necessary to shift the emphasis from minimizing the reduced costs or maximizing the excess of the reduced economic effect over the total present costs when assessing organizational and technical solutions in favor of maximizing a multifactor quality indicator that characterizes the degree of satisfaction with the results of the ICP by all its interested parties – stakeholders.

The interpretation of the value-oriented management concept, which originated from English-speaking countries, is subject to diverse interpretations among both Russian and foreign researchers [1, 2, 3]. This is partly due to the fact that in the English language, there is no semantic separation of the concepts of “cost” and “value”, therefore, historically, two directions in value-based management have developed. The first, represented as Value-Based Management, defines the purpose of a business as maximizing its value to capital providers. The second, based on Stakeholder Theory, insists that a business should benefit not only its owners, but also everyone it touches in one way or another – society, consumers, partners, nature, and even future generations.

The target function of the company in the case of value-oriented management based on taking into account the interests of stakeholders and their groups is multifactorial, the circle of stakeholders tends to infinity, and the priorities of their interests are not easy to determine. An example of this approach in enterprise management is the Balanced Scorecard, or BSC.

The basic mechanisms of value-oriented management of project activities are set out in the Project and Program Management (P2M) standard [4, 5]. The value management process, according to P2M, involves its continuous assessment. Value management aims to maximize outcomes for all stakeholders engaged in the management process. However, the approach to determining value or balancing stakeholder interests is not disclosed.

The interest of stakeholders is their desired economic, social, psychological, resource and any other expected benefit from the project. The value of the project will be expressed by the degree to which the project results correspond to the interests of its stakeholders.

Balance and conflict of interests are two opposing states of relations between stakeholders. A conflict of interest can be formulated as a structural imbalance in the distribution of economic, social, psychological, resource and other benefits between stakeholders, which causes instability and threatens the collapse of the system. Accordingly, the balance of interests is a structural proportion in the distribution of relevant interests between stakeholders, ensuring the stability and synergy of the system.

## **2 Materials and Methods**

The key ICP stakeholders are: customer, investor, developer, general contractor, subcontractor, designer, professional, scientific and creative organizations, user, local community and government authorities.

**Table 1.** Main stakeholders of the project, their functions and interests (stakeholder map for a typical ICP)

Business entity	Main functions	Interests of stakeholders
Investor	Persons investing their own or borrowed funds in construction	Obtaining the planned profitability of the project, reducing risk, increasing reputation, reducing project implementation time
Customer	Persons authorized by investors who implement investment projects	Reducing project implementation time, reducing project costs, increasing profits, improving the quality of project management
Developer	A person providing construction on a plot of land belonging to him	Increasing the value of land
General contractor	Persons who are direct performers of work under a contract	Reduced direct costs, reduced overhead costs, reduced construction time, reduced material and labor intensity
Subcontractor	A specialized contractor engaged on contractual terms to perform individual installation and special construction work at a facility under construction	Reduced direct costs, reduced overhead costs, reduced production time, reduced material consumption, reduced labor and machine intensity
Designer	Organization that develops project documentation	Reduced design costs, reduced design labor intensity, increased level of interaction with other participants
Suppliers	Suppliers of material and technical construction resources	Increase in sales, increase in manufacturability of assembly and installation of structures, reduction in the number of standard sizes, reduction in costs, reduction in logistics risk
Designer	Individuals and legal entities operating the property	Satisfying needs, improving quality, reducing acquisition costs, reducing operating costs, increasing post-warranty service, increasing environmental friendliness
Suppliers	State federal, regional and local authorities	Increasing the collection of taxes, payments, fees, increasing the level of support for the implemented strategy for the territory development, reducing public risk

Project participants, such as builders, designers or operating organizations, being its stakeholders, are not capable of fully managing the creation of project value at all stages, since they interact with it only during a certain period. The investor, in the case when he acts as the initiator of the project, lays down at the stage of the investment idea, among other things, the characteristics of the value of the results, but he is interested in managing the achievement of the necessary parameters only until the stage of return on investment, which, as a rule, occurs before the stage of housing operation.

The most promising subject of the value-oriented management under consideration is the developer. They are the ones who are able to effectively cope with all the problems of

construction and operation, as they guide the object from the investment plan throughout its entire life cycle. Therefore, it is in their interests to ensure maximum value of the project at all stages, as well as maintaining a balance of interests of all stakeholders. Therefore, the analysis of organizational and technical solutions must be carried out from his point of view.

The interests of stakeholders in the proposed concept are reflected at the stage of forming the investment plan. Under the influence of the interests of stakeholders, identified already at this stage, goal setting occurs, and measurable goals of the project are formed. In the current practice of housing construction, the goals of the project are formed by the investor independently or together with the designer, based on their interests and taking into account their own understanding of the interests of future users.

Next, they are fixed in the design assignment, according to which design and estimate documentation is carried out. Then, based on the agreed documentation, construction takes place, during which the interests of stakeholders are monitored, especially those whose interests can change under the influence of external factors.

If necessary, adjustments are made to the project. After completion of construction, the operation stage begins. During this stage, the monitoring of stakeholders' interests is conducted, taking into consideration the life cycle's duration of up to 100 years as specified in the current regulatory documentation.

Let us briefly summarize the provisions of stakeholder theory and the arguments in favor of using the concept of value-based management for the economic justification of the choice of organizational and technical solutions.

Firstly, the interests of all stakeholders potentially have the right to be taken into account in the economic justification for the choice of organizational and technical solutions.

Secondly, the target group responsible for making decisions regarding the choice of organizational and technical solutions is the project management.

Thus, the basic principles of technical and economic assessment and selection of design solutions based on the concept of value-based management can be presented as follows.

First, the interests of the main ICP stakeholders must be taken into account when determining the effectiveness of a design solution.

Secondly, the level of project effectiveness is determined by the rationality of decisions made in individual parts of the project and the rationality of their interrelation, which predetermines the complexity of the assessment.

Thirdly, the choice of a design solution presupposes the comprehensive nature of the process of determining economic efficiency with the most complete identification of costs and results for the entire period of project implementation, with the maximum possible cost assessment of the effect elements and resource costs.

Technical, technological and organizational solutions that are developed as part of the ICP can be characterized in general from an economic point of view using indicators of the investment project effectiveness [6, 7].

Not only the investment project as a whole, but its individual parts at different stages of its implementation should be subject to economic assessment, which makes it possible to take into account a number of factors related to the external and internal environment of the project.

As a methodological basis for the problem to be solved, choosing the best one from a set of alternative design organizational and technical options, the method of comparative economic efficiency can be used, i.e., the indicators of costs and results for the options are compared, and it is established how much more effective one option is than the other.

Since options for design solutions most often differ both in costs and in final results, when making a choice of organizational and technical solutions, it is advisable to conduct a

comprehensive analysis of the achieved result and the incurred costs. In order to determine the economic feasibility and make a final decision on selecting the optimal solution, it is essential to compare the options developed with an equal level of detail. Only through this comparison can a conclusion be drawn and a well-informed decision be reached.

### 3 Results

Let us consider the efficiency criteria and the composition of indicators that can be used in the technical and economic assessment of organizational and technical solutions.

Based on the type of criterion used to select the best option, design solutions can be combined into four groups, a brief description of which is given in Table 2.

**Table 2.** Types of organizational and technical solutions by type of efficiency criterion used

Project characteristics	Performance criterion
Type I - external requirements for the project are clearly and strictly specified, regulations and standards are widely used	Minimum total present costs under the restrictions imposed by goals and resources, taking into account the options for using the latter
Type II - external requirements for the project are not strictly specified; possible differences in the final results (economic, social, time factor)	Minimum total present costs, taking into account differences in economic results
Type III - the project has several heterogeneous goals (social, environmental, production), which cannot be fully assessed and strictly measured	Maximum multifactor quality indicator
Type IV - a separate projected event of a socio-economic nature	The maximum excess of the reduced (over the life of the facility) socio-economic effect over the total reduced costs of implementing the activity

The assessment of organizational and technical solutions using the concept of value-based management based on stakeholder theory is best suited to type III.

The value of the multifactor quality indicator (efficiency criterion for type III projects) can be determined as follows:

$$EC(III) = \sum_{k=1}^K (O(k) \cdot a(k)) \quad (1)$$

where  $O(k)$  – an indicator of autonomous performance assessment based on the compliance of an organizational and technical solution with the  $k$ -interest of stakeholders (can be presented not only in the form of a vector, but also in the form of a matrix, where each stakeholder is associated with a set of interests);  $a(k)$  – significance (weight) of  $k$ -interest in the formation of a complex indicator.

From the point of view of stakeholder theory, this criterion should reflect the quantitative and qualitative properties of the ICP in terms of satisfying the interests of stakeholders, as well as the given costs of its implementation, and can be presented as follows:

$$EC = \frac{\sum_{k=1}^K (O(k) \cdot a(k))}{PV} \quad (2)$$

The total present value (PV) is determined as follows:

$$PV = \sum_{n=N_c}^0 (K(n) \cdot \alpha(n, E)) + \sum_{n=1}^{N_o} (C(n) \cdot \alpha(n, E)) \quad (3)$$

where  $N_o$  – year of project liquidation, counted from the beginning of the operational stage of the project;  $N_c$  – year of commencement of implementation of the ICP, counted from the moment of its commissioning;  $K(n, E)$  – costs of implementing an organizational and technical solution in the  $n$ -year;  $C(n)$  – operating costs in  $n$ -year;  $\alpha(n)$  – reduction factor (discounting) for  $n$ -year.

The developed integral criterion is intended to evaluate organizational and technical solutions that do not affect cash inflows from the implementation of ICP.

In the methodology of functional cost analysis, a visually similar integral criterion is used to choose options for organizational, technical, and technological solutions [8, 9, 10].

Indicators characterizing the interests of stakeholders can be based on cost, natural, relative and quality indicators of ICP.

To assess organizational and technical decisions that affect cash inflows from the implementation of ICP, the developed integral criterion can be modified as follows:

$$EC = \sum_{k=1}^K (O(k) \cdot a(k)) \frac{\sum_{n=1}^{N_o} ((EE(n) - C(n)) \cdot \alpha(n, E))}{\sum_{n=N_c}^0 (K(n) \cdot \alpha(n, E))} \quad (4)$$

where  $EE(n)$  – economic effect (income) in  $n$ -year.

This indicator is an index of profitability of discounted investments in the implementation of an organizational and technical solution, adjusted by the value of a multifactor quality indicator that takes into account the interests of stakeholders.

When developing an ICP, several options are usually considered, differing in technical, technological or other design solutions. In such cases, effectiveness must be assessed for each of the considered project options.

Unlike investment projects implemented in other sectors of the economy, private investment projects have their own specific features that must be taken into account when developing project documentation and assessing effectiveness.

When modeling ICP cash flows, there are a number of features when determining the size of capital investments, the net current costs of production and sales of products in the production of which constructed facilities are involved.

When modeling ICP cash flows, the size of capital investments is determined based on the preparation of estimate documentation, the composition and methods of preparation of which differ depending on the availability and level of elaboration of project documentation.

Activities in the field of construction and reconstruction of facilities are characterized by the following technical and economic features, which affect the pricing mechanism of their cost and determine the specificity of methods for determining the amount of investment in the implementation of ICP.

Firstly, construction products are diverse and each construction project is unique. From a pricing point of view, this means that each type of construction product has its own individual price.

Secondly, the process of organizing and implementing construction takes a long time. In the presence of even moderate inflation, the estimated cost of construction products, calculated at the design stage, will not coincide with the actual cost formed during the construction process. The described situation assumes that participants in construction investment projects take into account the time factor when forming the limit of funds allocated for construction.

Thirdly, construction products are resource-intensive. When implementing a medium-sized construction investment project, the number of types of resources used can reach several thousand or tens of thousands.

Fourthly, when forming the estimated cost of construction products, each of the participants in the construction investment project pursues its own goals. As a result, the final price of construction products is a compromise that suits all stakeholders.

ICPs are characterized by a long life cycle and several successive stages: pre-project justification, design, construction, effective operation, at each of which it is advisable to achieve different results.

The time duration of investment costs and return requires taking into account the time value of money and uncertainty in terms of costs incurred and results obtained in the future (the degree of this uncertainty can vary significantly).

The evaluation of the effectiveness of ICP, utilizing the value-based management concept rooted in stakeholder theory, is conducted under the assumption that the interests of stakeholders impact variations in project performance:

- 1) either through a change in the flow of income and expenses;
- 2) either through a reduction in risk, and hence the discount rate.

Due to the many quantitative and qualitative factors to be taken into account, as well as due to the complexity of forming a complex indicator based on them that would take into account the interests of all persons interested in the implementation of the project, the use of this approach is a non-trivial task, and therefore its use in practice to assess the complex organizational and technical solutions are difficult. However, a complete rejection of this approach is not advisable, but in order to simplify the assessment, it can be used to take into account individual factors.

However, to simplify calculations and provide clarity, the approach we proposed earlier can be used: adjusting the criteria for the effectiveness of an investment project by the value of a multifactor qualitative indicator that characterizes the level of stakeholders' interests.

The following indicators can be used as such indicators:

- 1) static (simple) indicators (net income and investment return index);
- 2) dynamic (discounted) indicators (net present value, discounted investment return index, internal rate of return of an investment project)

For example, it is proposed to determine the profitability index (PI) of discounted investments as follows:

$$PI = \sum_{k=1}^K (O(k) \cdot a(k)) \frac{\sum_{n=1}^{N_0} (\varphi_0(n) \cdot \alpha(n, E))}{\sum_{n=N_c}^0 (\varphi_n(n) \cdot \alpha(n, E))} \quad (5)$$

Thus, the application of the developed methods will make it possible to take into account the influence of stakeholders' interests on the ICP when assessing and selecting organizational and technical solutions without complicating the calculations.

It should be noted that the use of the developed method is advisable not only in the situation of having complete and reliable information about the adopted organizational and economic mechanism for implementing the ICP, but also at the stages preceding its formation and when choosing it. In this instance, the individual interests of particular stakeholders can be substituted with the collective interests of stakeholder groups.

## 4 Conclusion

Increasing the efficiency of investments is connected and has a direct dependence on the three main controllable parameters of the investment project: duration, cost and quality. It is they who ultimately determine the content of the ICP, which depends on the ratio of these parameters.

The increase in the efficiency of ICP implementation is caused by a reduction in the cost of capital and operating costs, a reduction in construction time, an increase in the quality of construction products and is achieved through the use of optimal organizational and technical solutions developed within the framework of the project.

In this study, a working hypothesis was put forward about the need to shift emphasis from minimizing the reduced costs or maximizing the excess of the reduced economic effect over the total present costs when assessing organizational and technical solutions in favor of maximizing a multifactorial quality indicator characterizing the degree of satisfaction with the results of the ICP by all its interested parties – stakeholders.

## Reference

1. Fil O.A., Yurchenko R.S. Improving the management system for investment and construction projects // IVD. 2016. No. 4 (43). URL: <https://cyberleninka.ru/article/n/sovershenstvovanie-sistemy-upravleniya-investitsionno-stroitelnyimi-proektami> (access date: 30.09.2021).
2. Shevchenko A.A. Value-oriented management in construction and real estate development // The Eurasian Scientific Journal. 2020. No. 6. URL: <https://cyberleninka.ru/article/n/tsennostno-orientirovannoe-upravlenie-v-stroitelstve-i-razvitiye-nedvizhimosti> (access date: 30.09.2021).
3. Babaeva M. S. From the interests of shareholders to the interests of broad interested groups in the basis of strategic business sustainability // Vestnik MGSU. 2016. No. 10. URL: <https://cyberleninka.ru/article/n/ot-interesov-aktsionerov-k-interesam-shirokih-zainteresovannykh-grupp-v-osnove-strategicheskoy-ustoychivosti-biznesa> (access date: 30.09.2021).
4. Sotnikov D.O. Identification of problem areas for the development of effective interaction in the construction sector // Innovations and investments. 2020. No. 4. URL: <https://cyberleninka.ru/article/n/vyavlenie-problemnykh-oblastey-razvitiya-effektivnogo-vzaimodeystviya-v-stroitelnoy-sfere> (access date: 30.09.2021).
5. Sergeeva D.P. Russian and foreign methodological recommendations for assessing investment projects // Innovative science. 2015. No. 9. URL: <https://cyberleninka.ru/article/n/rossiyskie-i-zarubezhnye-metodicheskie-rekomendatsii-po-otsenke-investitsionnykh-proektov> (access date: 25.05.2021).
6. Sirotkin S.A., Kelchevskaya N.R.. Present costs: is there a future // Bulletin of USTU-UPI. 2008. No. 3. URL: [https://elar.urfu.ru/bitstream/10995/54135/1/vestnik\\_2008\\_3\\_002.pdf](https://elar.urfu.ru/bitstream/10995/54135/1/vestnik_2008_3_002.pdf) (access date: 06.05.2021).

7. Construction in the digital economy: prospects and areas of transformation / V.S. Kankhva, Ya.A. Andryunina, S.V. Belyaeva, Ya.L. Sonin// E3S web of conferences. XXII international scientific conference energy management of municipal facilities and sustainable energy technologies (EMMFT-2020). - 2021. - C. 05008 DOI: 10.1051/e3sconf/202124405008
8. Implementation of innovative strategy in underground construction as a basis for sustainable economic development of a construction enterprise/ Uvarova S.S., Belyaeva S.V., Kankhva V., Vlasenko V.// In collection: Procedia Engineering. 2016. C. 1317-1322 DOI: 10.1016/j.proeng.2016.11.857
9. Lavagnon A., Jonas I, Landoni S.P. When project management meets international development, what can we learn? // International Journal of Project Management. October 2020. URL: <https://reader.elsevier.com/reader/sd/pii/S0263786320300879?token=911E184B414C7B521920C8F706C4DA3946B27C27BFBE823522EC4205A36A08F2BAAC812169D83FC452338B768422228F&originRegion=eu-west-1&originCreation=20210502115951>
10. Koops L., Bosch-Rekvelde M., Bakker H. Identifying perspectives of public project managers on project success: Comparing viewpoints of managers from five countries in North-West Europe // International Journal of Project Management, Volume 34, Issue 5, July 2016, Pages 874-889. URL: <https://www.sciencedirect.com/science/article/abs/pii/S0263786316300060>