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Development of methods of monitoring and selecting an outsourcer to create engineering underground structures as a factor of sustainable development of territories

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The relevance of the research is due to the fact that currently in Russia there is an acute problem of sustainable development of territories, especially Western and Eastern Siberia, the Far East. In this regard, it is planned to implement investment projects aimed at developing the infrastructure of the region and providing for large-scale construction. This process is characterized by the need for outsourcing when performing construction and installation works and, therefore, the evaluation and selection of an outsourcing organization. However, at present, there is no single methodology for monitoring and selecting an outsourcer.

The aim of the study is to develop a methodological approach to the process of monitoring and selecting an outsourcer in the implementation of national projects for the development of the territories of the Far Eastern Federal District.

Methods of research. The paper used methods of analysis and generalization of specialized literature on the problems of sustainable development of territories, evaluation the effectiveness of investment projects, as well as system analysis, empirical, and general logical research methods.

The result is a technique proposed for practical use, which allows the "Price" criterion to be correlated with the value of possible environmental and economic damage due to structural and geological factors and to make effective management decisions based on the data obtained when implementing the monitoring process and selecting an outsourcing organization. Within the framework of the methodology, an economic-mathematical model for assessing possible economic damage has been developed.

Conclusions. The developed methodology, in conditions of the strategic need for spatial development of Russia, specifies not only a list of the main criteria for monitoring and selecting an outsourcer, but also allows preventing possible environmental and economic damage, which will contribute to the sustainable development of the territories of the Far Eastern Federal District.

Keywords: sustainable development of territories, method of estimation of an outsourcer, selection criteria, ecological and economic damage, spatial development

Introduction

The term "sustainable development" was first introduced at the World Conference on Environment in Stockholm in 1972. Today, there are more than 100 interpretations of the concept of "sustainable development". The textbook or fundamental definition of sustainable development was introduced in 1987 by the World Commission on Environment and Development (WCED) directed by G. Kh. Brundtland at the 42nd session of the UN General Assembly in the report called "Our Common Future". "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1–3]. At the beginning of the XXI century, needs for the use of new management methods are reflected in the idea of sustainable development both at the level of territories and individual economic entities. The "Spatial Development Strategy" developed in Russia (project of the Ministry of Economic Development of the Russian Federation, 2016) suggests changes in the spatial (territorial) organization of society in order to develop the country's socio-economic system taking into account the impact of global challenges. As part of the strategy, some measures are planned; they are aimed at reducing the tendency that began in the 1990s, the downward trend in the share of the Russian economy of the strategically important macrozones called "Siberia" and "Far East". While macrozones are characterized by the relative proximity and transport accessibility of rapidly developing commodity markets in the Asia-Pacific region, they have the diversified economic complex, and include the main raw material entities of Western and Eastern Siberia, the Far East; their share in the cost of fixed assets of industries and the total gross regional product of the Russian Federation and population indicators has been reduced by 3%, 1%, 5% per year since the 1990s. In such conditions, the problem of sustainable development of macrozones "Far East" and "Siberia" is of particular relevance.

The state program called "Social and Economic Development of the Far East and the Baikal Region" adopted in the Russian Federation is aimed at solving the problems of sustainable development of territories. Within the framework of the program, it is planned to implement 23 complex investment projects providing more than 1/3 of the increase in GRP. The implementation of investment projects is aimed at developing infrastructure with the involvement of the region's mineral resources base in the economy and attracting 2.36 trillion rubles of extrabudgetary investments within the framework of mineral resource clusters. Integrated investment projects aimed at developing the territories of the Far East, the city of Vladivostok, tourist clusters, the creation a mining and metallurgical cluster in the Amur Region, suggest large-scale construction. At the same time, the neces-

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sary condition is the availability of uninterrupted, reliable water, electricity and heat supply for housing and industrial-civil construction, which implies the creation of underground engineering structures and, in turn, the planned and integrated use of the underground space. To perform construction and installation works, organizations usually use outsourcing. The selection of an outsourcer is carried out by means of contract bidding. Moreover, outsourcing is determined by the selection of criteria for evaluating the performance of contractors. It should be noted that today there is no methodology containing the optimal set of criteria and satisfying the interests of all participants in the construction process. Thus, the development of methods for monitoring and selecting an outsourcer for the implementation of construction projects is an urgent scientific task.

Methods of research

These methods include analysis and generalization of specialized literature, publications in periodicals devoted to the problems of sustainable development of territories, assessment of the effectiveness of investment projects, as well as system analysis, comparison, empirical, and general logical research methods.

Discussion

The main approaches to the selection of criteria for evaluating the performance of contractors engaged to state and municipal needs are given in the Federal Law No. 44-FZ dated on 05.04.2013 “On the contract system in the procurement of goods, works and, services to ensure state and municipal needs”. There are 6 selection criteria:

1. Contract price;
2. Expenses for operation and repair of goods, for use of work results;
3. Terms of delivery of goods, completion of works, provision of services;
4. Qualitative, functional and environmental characteristics of the volume of procurement;
5. Terms of guarantee as to the volume of procurement;
6. Qualification of bidders in procurement proceedings.

In large (strategic) companies (Gazprom, Rosneft), a contractor is selected based on an assessment of its compliance with corporate rules (standards).

Currently, the research has been conducted on the topic of the optimal choice of an outsourcing company, various selection methods have been developed, evaluation criteria have been determined [4, 5]. The analysis of existing methods and the criteria contained therein is given here (Table 1).

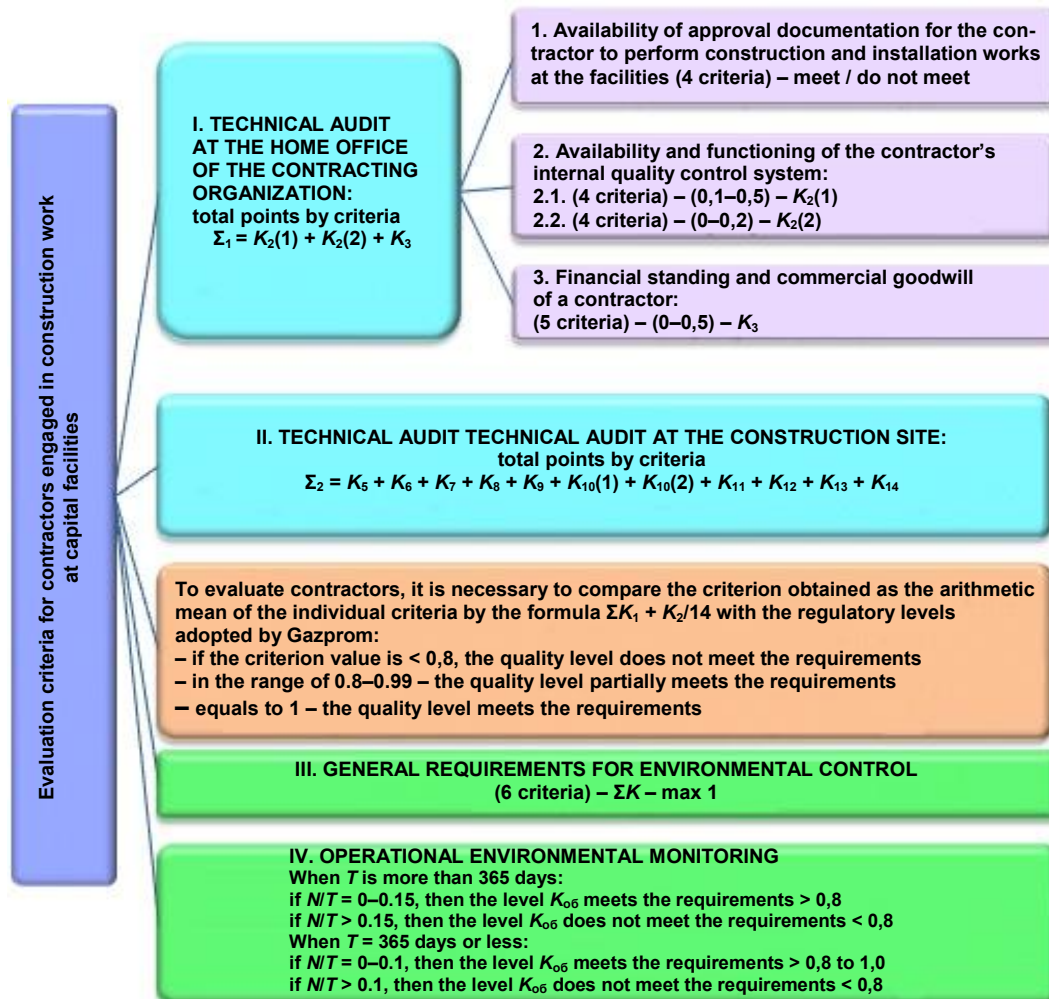


Figure 1. Evaluation criteria for companies carrying out construction work at capital construction projects as part of outsourcing.
Рисунок 1. Критерии оценки организаций, осуществляющих производство строительных работ на объектах капитального строительства в рамках аутсорсинга.

Table 1. Comparative analysis of existing methods for evaluating outsourcing companies.**Таблица 1. Сравнительный анализ существующих методик оценки компаний-аутсорсеров.**

Authors of the methods	The essence of the methods	Criteria for selecting a contractor
P. V. Gentzler	Selection of a contractor according to the established criteria (8 criteria)	<ol style="list-style-type: none"> 1. Qualification 2. Willingness to get started quickly 3. Related specialties 4. Physical well-being of workers, lack of bad habits 5. Material and technical resources 6. Goodwill 7. Contractor price 8. Warranty period of work execution
P. V. Zhanov	Selection of a contractor according to the established criteria (4 criteria)	<ol style="list-style-type: none"> 1. Reputation 2. Contractor price 3. Term of completion of works 4. Accuracy of execution
T. N. Soldatenko	The model has been created for a comprehensive indicator of business reputation based on expert evaluation of the significance of factors in the structure of business reputation (8 criteria)	<ol style="list-style-type: none"> 1. Qualification 2. Material and technical resources 3. Contractor's reputation 4. Price 5. Warranty period of work execution 6. Term of contract 7. Quality of execution 8. Trust of banks
A. M. Akinpelu	Selection of a contractor according to the established criteria (5 criteria)	<ol style="list-style-type: none"> 1. Contractor's reputation 2. Contractor price 3. Accuracy of implementation of commitments 4. Trust of banks 5. Assistance in the implementation of the project
M. V. Demidenko	Selection of a contractor according to the established criteria (6 criteria)	<ol style="list-style-type: none"> 1. Qualification 2. Contractor price 3. Term of the contract (performance of works) 4. Guarantee of performance of works 5. Liability insurance 6. Refusal to prepayment
T. V. Nakashidze	A scoring system based on the matrix mechanisms of a comprehensive risk assessment of the choice of a contractor has been developed (5 criteria)	<ol style="list-style-type: none"> 1. Qualification 2. Various experts 3. Material and technical resources 4. Contractor's price 5. Quality of execution
Yu. V. Vedernikova	Model with the best set of criteria	Set of criteria depending on the project with a mandatory assessment of the customer's professional experience with a contractor and the labor intensity of the project
Zh. B. Dorokhova	Automation of the business process of selecting a contractor using the COBRA++ system	Software systems are used in real time covering an overview of all stages of construction, not requiring a choice of criteria
Sobah Abbas Petersen	A program in which a number of "competency questions" are asked for a particular contractor	After answering a number of competency questions for specific contractors, the tender organizer receives an estimate for this agent

PAO Gazprom has developed a method of corporate evaluation of general contractors, which contains more than 120 evaluation criteria that meet the requirements of the legislation of the Russian Federation in the field of construction, design and survey work [6, 7]. As a result of the analysis and processing of the criteria for evaluating the performance of the contractor, the appropriateness of its cooperation with the Gazprom Group companies is determined (Fig. 1).

The analysis allows us to conclude that there is no single methodology that meets the interests of all participants in the construction and contains the optimal set of criteria. The only criterion is "Price", which can be found in all methods. "Price", of course, is an important criterion for choosing an outsourcing company, but not a determining one. The cheapest contractor is not always the best, since the possible problems with it can have a much greater impact on implementation of the project than the initial cost savings. In addition, it is necessary to take into account the possibility of various risks associated with the construction processes and subsequent operation of facilities [8–11]. It should be noted that none of the existing methods takes into account the probability of occurrence of negative events in the process of construction and operation of the facility due to the presence of structural and geological factors, and the consequent possible economic damage [12].

The study proposes the developed methodology for monitoring and selecting an outsourcer during construction and installation work, taking into account a certain list of quantitative and qualitative assessment criteria established depending on the conditions of the project and at the discretion of the customer, as well as the mandatory consideration of the possible economic damage that may occur as a result of negative events during the operation of facilities [13–15].

Taking into account the physical and mechanical properties of building structures and materials (strength, corrosion resistance, etc.), the state of the geological environment of the underground space (groundwater, dangerous geological processes, soil properties, etc.), partial or complete failure may occur during the operation of underground structures system or its constituent elements and the inevitability of the occurrence of negative technological changes in the environment, which will require additional funds to eliminate the consequences of emergencies. Therefore, when choosing an outsourcing organization, it is necessary

Table 2. Basic failures in communication systems and recommendations for restoring the reliability of their functioning.
Таблица 2. Основные отказы в коммуникационных системах и рекомендации по восстановлению надежности их функционирования.

Physical disturbances arising from the system	Possible consequences from emerging disturbances	Necessary measures to restore the reliability of the system	Inflation index for costs β
Severe corrosion damage to the supporting structures of the lining	Reduced bearing capacity of the support, deformation and destruction of mining production	Complete overhaul with the removal of used lining, opening the trenches of the route and backfilling	≥ 1
Disruption of integrity of underground structure supports, ruptures/shear fractures of bolt junctions	Leaks, returns, deformations, subsidence, violation of dimensions, reduction of operational reliability of mine workings	Partial repair of the support in the places of its deformation	0.3–0.5
Lost of host rocks adjacent to the mine working supports	Propagation of deformation of supports, reduction of bearing capacity of the support, detachment of the trough block, violation of dimensions	Partial repairs of supports and cementation of host rocks around workings	0.4–0.5
Water resistance disturbance of the system with water ingress to electrical equipment, water main pipes and discharged water in the underground sources	The possibility of the lost of rocks, poisoning of drinking springs, the creation of emergency situation	Cementation of the host rocks around the working, waterproofing of the supports, making cement screed	0.8–1.0
Formation of frost on the elements of underground structures	Distortion of the cross-section, equipment failures, cable breakage, defects and damage creation	Partial repairs of the support inside the system	0.3–0.4
The silting of the open or closed drainage systems	Structures flooding	Partial repair with cementation of the fixed space, local drainage	0.5–0.6
Super-permissible deflections of beams and floor slabs	Cracks in the tensioned zone waterproofing defect, leaks, corrosion of fittings, structural failure	Partial or complete overhaul of the system	0.8–1.0
Hyperadmissible ellipticity of rings of the support	Irregularity of dimensions, reduction of bearing capability of the support	Partial or complete overhaul of mine working	0.8–1.0

to be guided not only by the amount of direct construction costs (“contractor’s price”), but also consider the amount of cost to restore the system. The studies have determined the possible main failures occurring in communication systems, given the recommendations of necessary measures to restore the reliability of their functioning, the coefficient of cost increase (Table 2).

The amount of possible economic damage is recommended to be calculated by the formula (taking into account the time factor if necessary):

$$E_y = [(S_{tr} - L_t) \times \Delta Q \times t_{rec} + S_{rec} + S_c + S_{en}]P_o,$$

where S_{tr} is the price of transporting resources through the communications system, rubles/unit; L_t – costs of transportation of resources, rubles/unit; ΔQ – decrease in the volume of transportation of resources upon failure, units/year, months; t_{rec} – system recovery period, years, months; S_{rec} – system recovery costs, rub.; S_c – compensation payments to enterprises whose economic indicators have worsened, rub.; S_{en} – environmental damages payment, rub.; P_o – probability of failure, unit fraction.

Conclusions and results

The developed methodology allows the implementation of the monitoring process and the selection of an outsourcing organization to correlate the “Price” criterion with the amount of possible economic damage due to the presence of structural and geological factors and make effective management decisions based on the data obtained.

Thus, for the sustainable development of the territories of the Far Eastern Federal District, taking into account the necessary limitation of negative impact on the environment and ensuring the protection and rational use of natural resources, it is recommended to use the developed methodology for monitoring and evaluating an outsourcer considering not only criteria indicators, but also the amount of likely economic damage due to the onset of negative events during the operation of facilities.

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Разработка методики мониторинга и отбора аутсорсера для создания инженерных подземных сооружений как фактор устойчивого развития территорий

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Актуальность исследования обусловлена тем, что в настоящее время в России остро стоит проблема устойчивого развития территорий, в особенности Западной и Восточной Сибири, Дальнего Востока. В связи с этим предусмотрена реализация инвестиционных проектов, направленных на развитие инфраструктуры региона и предусматривающих масштабное строительство. Данный процесс характеризуется необходимостью применения аутсорсинга при выполнении строительно-монтажных работ и, следовательно, оценкой и выбором организации-аутсорсера. Однако в настоящее время не существует единой методики мониторинга и отбора аутсорсера.

Целью исследования является разработка методического подхода к процессу мониторинга и отбора аутсорсера при реализации национальных проектов по развитию территорий Дальневосточного федерального округа.

Методы исследования. В статье использованы методы анализа и обобщения специализированной литературы по проблемам устойчивого развития территорий, оценке эффективности инвестиционных проектов, а также системный анализ, эмпирические, общелогические методы исследования.

Результатом является предлагаемая для практического использования методика, позволяющая при осуществлении процесса мониторинга и выбора организации-аутсорсера соотносить критерий «Цена» с величиной возможного эколого-экономического ущерба вследствие наличия конструктивных и геологических факторов и на основе полученных данных принимать эффективные управленческие решения. В рамках методики разработана экономико-математическая модель оценки возможного экономического ущерба.

Выводы. Разработанная методика в условиях стратегической необходимости пространственного развития России конкретизирует не только перечень основных критериев для мониторинга и отбора аутсорсера, но и позволяет предотвратить возможный эколого-экономический ущерб, что будет способствовать устойчивому развитию территорий Дальневосточного федерального округа.

Ключевые слова: устойчивое развитие территорий, методика оценки аутсорсера, критерии отбора, эколого-экономический ущерб, пространственное развитие

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