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Methodological Aspects of Determining the Estimated (Marginal) Cost of Objects in the Implementation of Projects Based on the IPA

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ABSTRACT

The paper is devoted to the study of the issues of determining the estimated (marginal) cost of investment projects that are implemented within the framework of the IPA. The **purpose** of the study is to develop scientific and practical recommendations for determining the estimated (marginal) value of real estate objects created in the framework of investment projects implemented on the basis of the IPA. The paper is **relevant** because current regulatory documentation does not clearly define the concepts of estimated (marginal) cost of infrastructure objects, and there are no recommendations for their assessment, which leads to distortions of the cost base for obtaining subsidies and impacts the evaluation of the effectiveness of such projects. The **scientific novelty** of the research consists in the development of scientific and practical recommendations for determining the estimated (marginal) value of real estate objects created as part of an investment project implemented on the basis of the IPA. The authors used the following **methods** of scientific research: deduction, induction and logical method. The concept of the estimated (marginal) value of real estate objects is clarified, which is based on the estimated cost of construction, taking into account a certain number of assumptions. A review of the current methods of calculating the estimated value in Russia and abroad is conducted. It is **concluded** that in Russia there is no single base for determining the cost of the CIW. The basic index method in the prices of 2000–2001 significantly reduces the accuracy of calculations. The idea of forming a new dynamic system of the resource-index method, which takes into account the life cycle of a building and is based on big data of price information in construction, on the basis of which it is possible to develop a system of forecasting the estimated value of an object using machine learning methods, is prospective.

Keywords: estimated (marginal) value of real estate objects; investment promotion and protection agreements; estimated cost of construction

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INTRODUCTION

In accordance with the Federal Law of 01.04.2020 No. 69 "On the Protection and Promotion of Capital Investments in the Russian Federation" (hereinafter — 69 Federal Law) investment promotion and protection agreements (further — IPA) are intended to support large private investors in their implementation of new investment projects. It is proposed to resume the investment cycle in the Russian economy with the help of IPA for eight years (IPA concluded on 01.01.2030). The IPA parties are represented in *Fig. 1*.

The objective of the IPA is the implementation of a new investment project as a set of interrelated activities and processes, which can have two directions:

1) creation, construction, reconstruction, or modernization of real estate objects or a complex of related property objects and their subsequent operation;

2) creation and use of results of intellectual activity or means of individualization.

The purpose of the investment project is to produce a profit and/or other beneficial effect, including preventing or minimizing the negative impact on the environment.

The dynamics of investments in fixed assets in the range of regions of the Russian Federation (*Table 1*) have uneven changes in growth rates: for the Central Federal District, there is a decline in investment in 2022, although the average growth rate is the highest among all the districts; for the Southern and Volga Federal Districts, the trend is positive, but the average rate of growth for the South Federal District has not exceeded 100% in the last 5 years, as for the North Caucasus Federal District. The analysis's presented results indicate the need to match the rate of change of capital investment by Russian regions in order to increase the attractiveness of federal district territories for the local population and to reduce internal migration to the Central Federal District, which, among other things, solves many social problems. IPA-based projects are expected to solve this problem.

The dynamics of investment in fixed assets aimed at environmental protection (*Fig. 2*), show that there has been a sharp increase in such investments in 2021 compared to 2020, with a growth rate of 152.8%, and continued in 2022. During the 10 years from 2012 to 2022, this indicator grew 2.63 times.

The spheres of the economy in which investment projects can be realized under the terms of the IPA are of strategic importance for the economic development of the country and make a significant contribution to the amount of capital investment (*Table 2*).

Structure of investments (*Fig. 3*) indicates that from 2012 to 2022, their main share shifts from protection of water resources to protection of atmospheric air: the ratio of shares in 2012, 45% and 29.7%, respectively, and in 2022–36% and 45.4%. Investment projects on the basis of IPA are intended to increase the effectiveness of such investments in order to ensure the ecological sovereignty of Russia.

In the context of IPA application practice in general, it is important to note the complex problems connected to the receipt of a subsidy related to an estimated (marginal) value, the legal status of which is particularly problematic. To get financing, the organization must provide a report on the conduct of a technological and pricing audit from an expert organization within three years of the project's commissioning. The expert organizations are responsible for the accuracy and completeness of the material included in the audit report.

In international and federal valuation standards, there is no notion of the estimated (marginal) value of an object. However, the estimated (marginal) value is found in the context of the following regulatory instruments relating to tender procurement:

- Federal Law from 05.04.2013 No. 44 "On the contract system in the sphere of

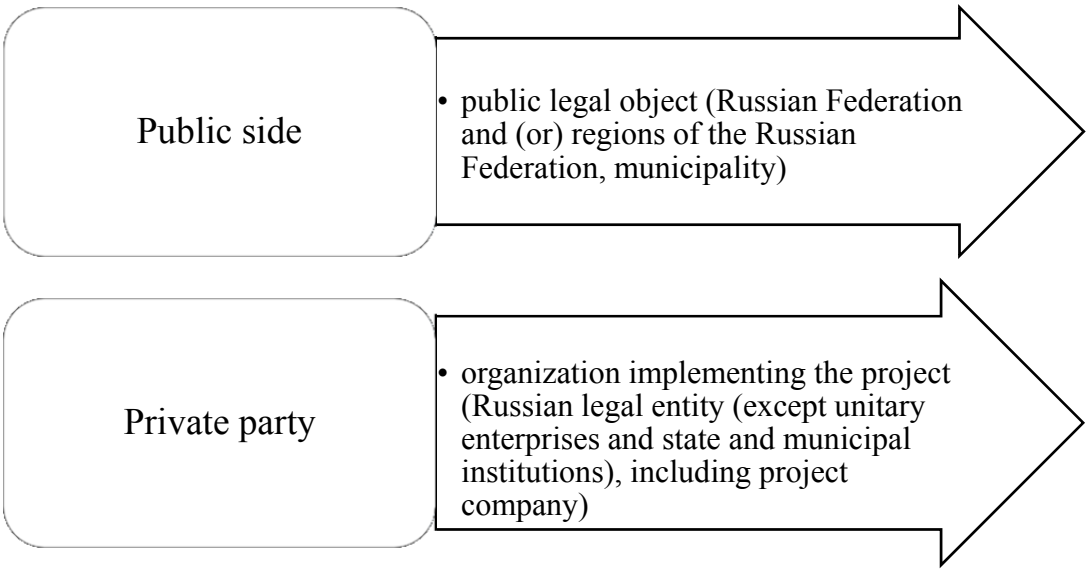

Fig. 1. **The Parties to the Investment Promotion and Protection Agreements**

Source: Compiled by the authors.

Table 1

Dynamics of Investments in Fixed Assets by District of the Russian Federation in 2018–2022 (in Comparable Prices; as a Percentage of the Previous Year)

Federal district of Russia	2018	2019	2020	2021	2022	Average growth rate
Russian Federation	105.4	102.1	99.9	108.6	104.6	104.1
Central FD	111.7	115.0	101.2	114.5	99.8	108.2
Northwestern FD	115.5	84.1	98.4	103.6	95.0	98.8
Southern FD	94.4	89.1	98.3	100.1	103.7	96.9
North Caucasus FD	101.2	107.7	106.5	98.9	107.9	104.4
Volga FD	99.3	102.9	98.2	104.8	103.5	101.7
Ural FD	105.8	94.1	101.2	100.0	110.0	102.1
Siberian FD	105.4	106.8	100.4	110.8	105.6	105.7
Far Eastern FD	106.2	108.8	94.0	114.2	110.8	106.6

Source: Developed by the authors according to Rosstat.

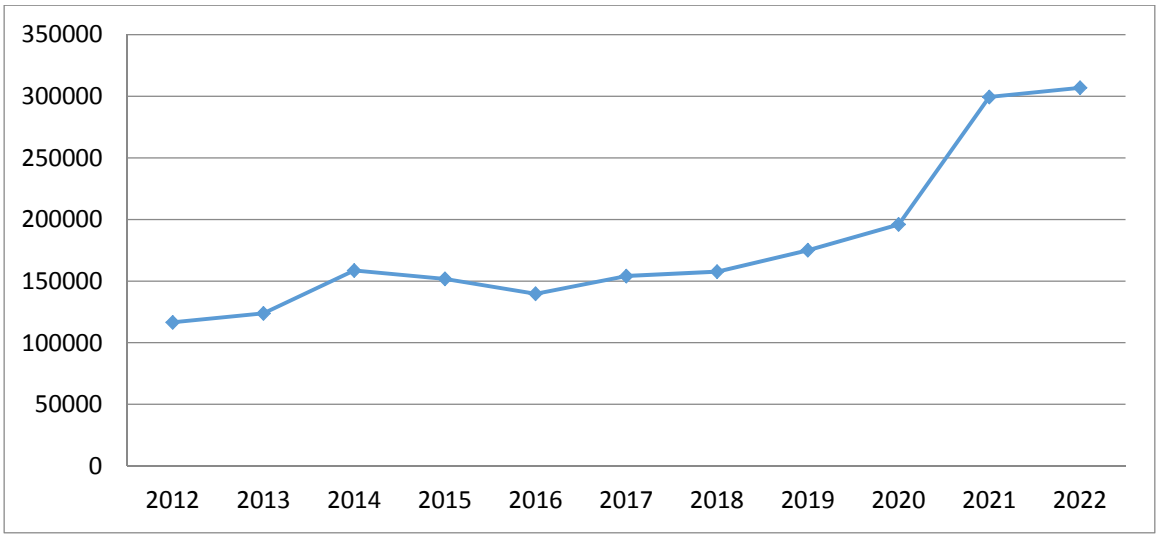

Fig. 2. **Investments in Fixed Assets for the Environmental Protection and Sustainable Use of Natural Resources in the Russian Federation in 2012–2022, mln rub.**

Source: Developed by the authors according to Rosstat.

Table 2

Investments in Fixed Assets by Type of Economic Activity, Billion Rubles

Industry	Year			
	2018	2019	2020	2021
Agriculture, forestry, hunting, fishing and fish farming	781.5	844.2	861.4	964.2
Manufacturing	2513.2	2707.6	2971.0	3423.7
Transportation and storage	3083.0	3315.9	3124.7	3759.4
Education	268.8	383.2	454.9	479.7
Health and social services activities	232.3	330.8	571.6	585.4
Cultural, sports, leisure and recreational activities	218.2	212.9	228.9	281.6
Total	17782.0	19329.0	20302.9	22945.4

Source: Developed by the authors according to Rosstat.

procurement of goods, works, services for the provision of state and municipal needs".[1] The law states that the estimated (marginal) value of the contract is determined by the customer, based on the value of goods, works, services, determined on the basis of their average market prices;

- Order of the Government of the Russian Federation from 12.08.2008 No. 590 "On the procedure for determining the limit indices of price change when concluding state contracts for

[1] Legal-reference system. URL: https://www.consultant.ru/law/podborki/predpolagaemaya%2528predelnaya% 2529_stoimost/ (accessed on 20.10.2023).

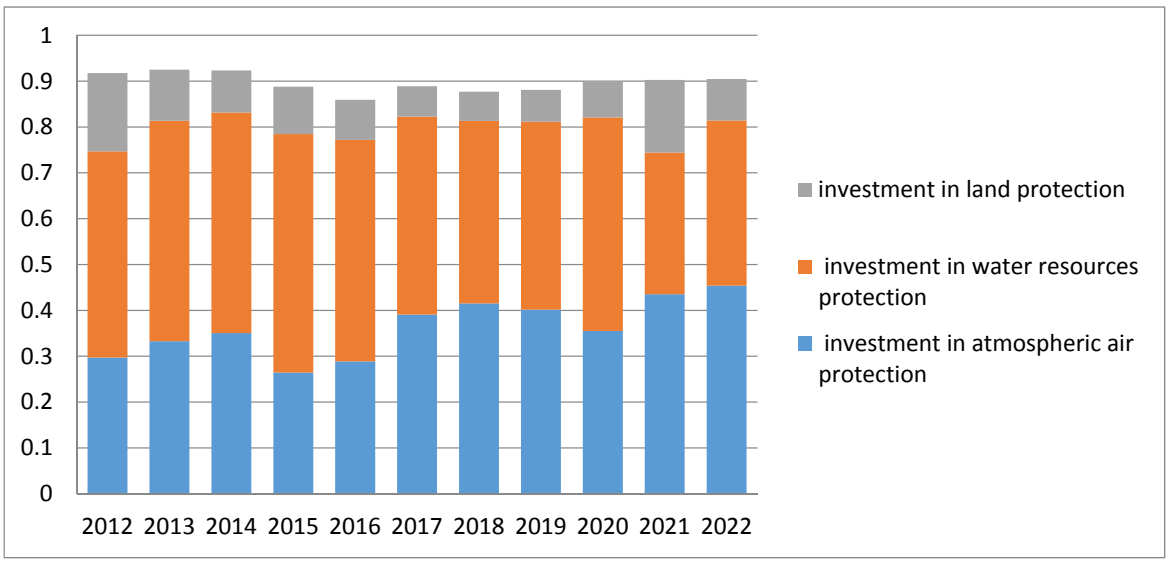

Fig. 3. **Structure of Investments in Fixed Assets for the Environmental Protection and Sustainable Use of Natural Resources in the Russian Federation in 2012–2022**

Source: Developed by the authors according to Rosstat.

the performance of works (provision of services) for state needs".[2] The order states that the estimated (marginal) value takes account of the client's planned expenses and expected inflation.

"In Order No. 1599,[3] it was noted that the determination of the presumed (limit) value is based on "the assessment of the justification of the choice of the main architectural, design, technological, and engineering solutions in terms of their optimality", as well as "the justification for the classification of an infrastructure object to the providing or associated infrastructure" and its conformity to "the needs of the project" [1]. It was also established that "the amount of the subsidy cannot exceed the estimated cost of establishing an infrastructure object" and "the costs actually incurred during the design and construction (reconstruction) of project infrastructure objects included in the estimate documentation are accepted as reimbursable".

Thus, in the context of real estate objects, according to the logic of the legislator, the estimated (marginal) value is understood as the estimated value of the object.

If, in the framework of procurement, the estimated (marginal) value is determined by the customer on the basis of market analysis, then within infrastructure properties, the algorithm of action is somewhat complicated, because there is no unified interdepartmental method of calculating the estimated value.

There are numerous intricacies and "bottom stones" in the computation of estimated value in the current world, because the structure of this notion remains unknown to many. This article discloses key information about the characteristics of calculating the estimated value of construction and installation work (further — CIW) for real estate in the modern world, the current structure of this process, as well as the problems associated with it.

[2] Legal-reference system. URL: https://rulaws.ru/goverment/Postanovlenie-Pravitelstva-RF-ot-12.08.2008-N-590/ (accessed on 20.10.2023).

[3] Decree of the Government of the Russian Federation from 3 October 2020 No. 1599 "On the procedure for granting from the federal budget of subsidies to legal entities (excluding state (municipal) institutions, state (Municipal) enterprises) for the reimbursement of costs for the establishment (building), modernization and (or) reconstruction of the provision and / or associated infrastructure necessary for the implementation of the investment project, in respect of which an agreement has been concluded on the protection and promotion of capital investments, as well as the cost of payment of interest on loans and loans, coupon payments on bond loans attracted for the specified purposes, and determining the amount of refund of these costs". Access the legal-reference system "Consultant Plus".

METHOD

E.B. Tyutyukina, T.N. Sedash [2], V.N. Lisitsa [3] and others have studied the financial aspects of the implementation of investment projects under the IPA. Pricing issues in the construction industry are discussed in papers by I.N. Polovtsev [4], D.B. Lavrent'ev [5], Somov M. Yu. [6], A.V. Rassokhin [7], N.B. Kudryashov [8], A.V. Smirnova, E.G. Degtyareva [9], K.A. Gureev, V.S. Gladkikh [10], A.V. Savchenko [11], V.D. Ardzinov, N.V. Chepachenko [12].

The publications examined include issues of history and difficulties with improving pricing, an analysis of the situation and possibilities for its development, as well as current pricing problems in modern construction.

However, not all issues relating to this topic were adequately covered. For example, these publications do not address issues related to the estimated (marginal) value of the IPA or the use of digital technology and artificial intelligence in building pricing.

The methodical basis for calculating the estimated value of real estate objects is based on the Methodology (hereinafter — Methodology) of calculation of estimated cost of construction of capital construction objects in the Russian Federation, which includes reconstruction and capital repairs. This Methodology is regulated in its current form by the Order of the Ministry of Construction of 04.08.2020.[4]

In terms of the conditions under which the Methodology's provisions are applied, these include projects involving the associated attraction of resources from the Russian Federation's budgets, structural legal entities of Russia, or legal persons in which Russia is more than 50% of the authorized capital. The methodology is used in the case of reconstruction, preservation or demolition of cultural heritage monuments.[5]

A consolidated estimate is a consolidated document describing all the calculations carried out within the framework of the project.

"The project estimates summarize all costs for the construction of buildings and structures: for each of the types of construction (e.g., general, sanitary, etc.); the purchase of equipment and its installation; the acquisition of production equipment, tools, appliances; for public buildings — economic equipment and objects of interior arrangement".[6]

Estimates of related expenses include costs that are not governed by standard estimates.

It is necessary to consider the key methods used in the formulation of the estimate, which include *resource*, *resource-index*, as well as *base-index.*[7] *It is important to understand that the realization of the formation of an estimate according to any of the listed methods involves the calculation of certain estimates, information on which is presented below.*

We will focus on the above-mentioned methods in detail. The **resource method** is based on estimations and pricing for the resources used, information about which is provided by the State in the specialized system (Federal State Information System — further FSIS). Accordingly, FSIS exists precisely for the regulation of the price level in the construction sector, and it was created in accordance with the Order of the Government of the Russian Federation of 23.09.2016.

Using a resource-based approach, the formulation of estimates implies a uniform

[4] Methodology for determining the estimated cost of construction, reconstruction of capital repair, demolition of capital construction objects, works on preservation of objects of cultural heritage (historical and cultural monuments) of the peoples of the Russian Federation on the territory of the Russia Federation: established by Order of the Ministry of Construction and Housing and Communications of Russia of 4 August 2021 No. 421.

[5] See ibid.

[6] See ibid.

[7] Methodology for determining the estimated cost of construction, reconstruction of capital repair, demolition of capital construction objects, works on preservation of objects of cultural heritage (historical and cultural monuments) of the peoples of the Russian Federation on the territory of the Russia Federation: established by Order of the Ministry of Construction and Housing and Communications of Russia of 4 August 2021 No. 421.

calculation of the direct for all three methods, including three components:

Cost = (Work intensity (people/hours) × Cost (people/hours)) + (Quantity (machine/hours) × Cost (machine/hours)) + (Material cost (pcs) × Cost of materials (pcs)).

Resource methods are divided into two groups: *classical* and *sequential*.

In the classical method, direct costs are generally estimated by calculating the total resource indicators of the estimate. At the same time, there is no work link. In the sequential method, direct costs are calculated for each work in the estimate line by calculating input resources, which are summed up in the same way as in the calculation of the unit rates.

The resource-index method involves consideration of three parameters in relation to the resources required for construction:

- estimated norms;
- estimated prices in base ratio (the value varies depending on the dynamic indices of the estimated value of unit prices);
- estimated prices according to the FSIS of pricing in construction (methods of estimate formation, information on prices for materials and labor, normative, lists of legal entities, etc.).[8]

The whole FSIS of pricing in construction contains a register of current regulatory and legal information, regulating the formation of estimates in the field of construction. According to FSIS terminology, this value is an estimated price.

Finally, the **basic-index method** is based on the use of single pricing as well as its deeper components in the formation of the estimate of the construction price. The unit rates are governed by the base prices, which in turn depend on the estimated price dynamics indicators described in the Federal Register of Estimates (further — FRE).[9]

Table 3 presents the advantages and disadvantages of two methods: the basic index and resource methods.

Thus, although the resource method is more accurate, it is difficult to use because of the large amount of work, while the basic-index method is simpler in calculations, but gives a fairly large error.

RESULTS AND DISCUSSION

To illustrate the work of the methods, we will calculate the estimate of the infrastructure object (external gas pipeline in the Moscow area) (*Table 4*).

Based on the calculations presented, it can be concluded that the deviation of the calculation results by the basic-index method, compared with the resource method, was 30%. This could lead to errors in planning and implementation, increasing the risk of project underfunding.

Based on the results of the comparative analysis of pricing systems in the construction industry in the UK, Germany, the USA and Russia (*Table 5*), it can be concluded that in Russia the most commonly used baseline-index method, in which the main work on valuation is carried out in the prices of the base, not the current period.

The basic-index method involves using the estimates of prices for the base year (2000–2001), which increase in accordance with the approved CIW value variation indices. For this reason, the cost of the CIW calculated in this way does not correspond to the actual cost and the value of the materials is taken from the contractor's prices, which leads to an increase in the price of the work. The use of the resource method for individual types of pricing improves the accuracy of the calculation, but the number of open pricings is not sufficient to convert all the estimates into a single type. Furthermore, the Russian cost

[8] Federal State Information System for Pricing in Construction. URL: https://fgiscs.minstroyrf.ru/ (accessed on 20.10.2023).

[9] Methodology for determining the estimated cost of construction, reconstruction of capital repair, demolition of capital construction objects, works on preservation of objects of cultural heritage (historical and cultural monuments) of the peoples of the Russian Federation on the territory of the Russia Federation: established by Order of the Ministry of Construction and Housing and Communications of Russia of 4 August 2021 No. 421.

Table 3

Comparative Analysis of Methods

Basis and index method	Resource method
Accuracy of the cost of construction	
"–" Prices are presented in the year 2000, the indices are averaged. Errors in estimates up to 25%	"+" The most accurate method of existing. It reflects the actual cost of construction
Labour-intensive calculation	
"+" Since all rates are already in the database, the counter spends less time and effort. If there are no prices in the estimations for the essential materials, only prices from price lists should be justified	"–" The most labor-intensive method, because it is necessary to find and confirm in monetary equivalent prices for materials, wages of labour of workers and mechanists, as well as regulatory indicators and the cost of operation of machines and mechanisms
Frequency and scope	
"+" The method received the greatest spread in the implementation of projects with budgetary investments	"+" Method has acquired recognition in companies that develop their own pricing
Transferring indices to a different price level is an option	
"+" Recalculation of estimates using indices is done for a few minutes of machine time, which allows you to get a quick result	"–" It is not possible to recalculate the cost of construction to another price level using indices, all prices need to be searched again

Source: Developed by the authors.

Table 4

Comparative Analysis of Cost Estimation Methods, Million Rubles

Type of work	Basis and index method	Resource method
Construction work	67.55	92.45
Installation work	18.69	17.77
Other work and costs	11.06	1.58
Labor funds	9.38	27.63
Total	106.68	139.43

Source: Developed by the authors.

assessment methodology does not take into account costs associated with the lifecycle of buildings or on the basis of work packages of significant cost [13].[10]

The moral obsolescence of the estimate base is that the reform of the system of calculating the cost of construction affects only the arithmetic calculation of norms and pricing and does not extend to the formation of a new normative base updated construction technologies and the updating.

Fig. 4 reflects the main problems in the system of estimates and ways to solve them.

It is advisable to establish a single, up-to-date source of information that can be used to calculate the limit value of the property.

[10] Tas Elcin, Yaman Hakan. Engineering, construction, and architectural management, 01 Jun 2005, Vol. 12, Issue 3, page s 251 – 263. URL: https://www.emerald.com/insight/content/doi/10.1108/09699980 (accessed on 20.10.2023).

Table 5

Methods Used in Foreign Countries

Country	Russia	USA	UK	Germany
Methods used	Basic-index, resource-index	Resource, resource-index		

Source: Developed by the authors.

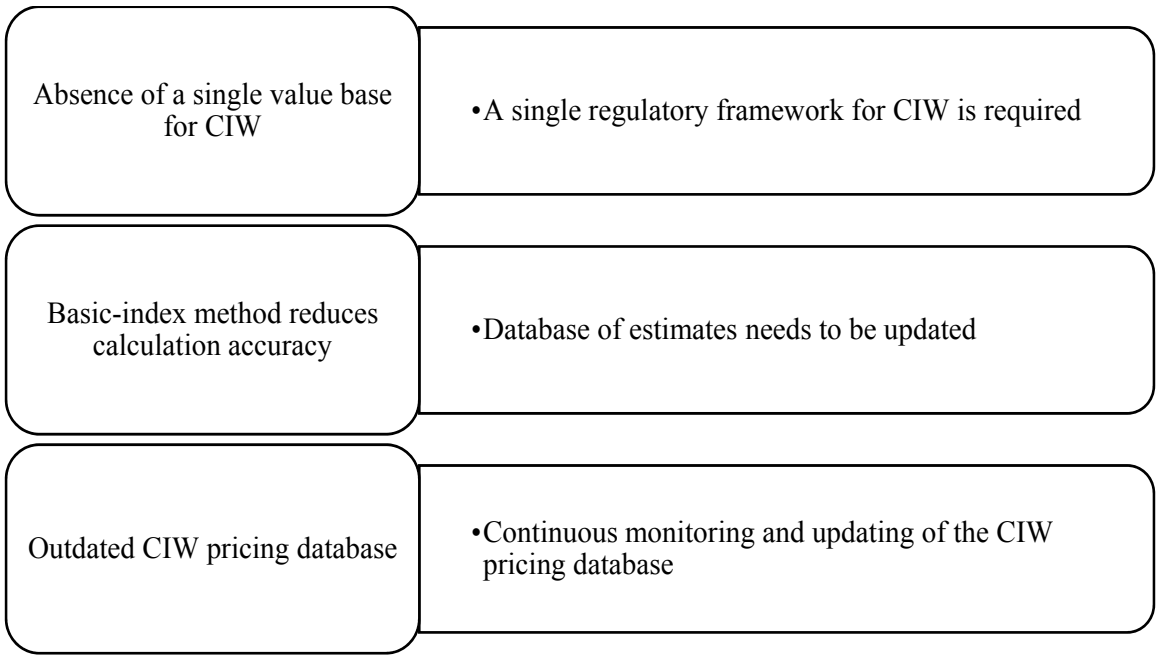

Fig. 4. **Problems and Possible Ways of Solving Problems in the System of Estimated Pricing in the Russian Federation**

Source: Compiled by the authors.

The creation of a single resource-based pricing base for different types of calculations can solve the problem of the inconsistency of estimates with the real cost of construction and will improve the accuracy of cost forecasts using machine learning methods.

When developing a methodology for calculating the estimated cost of a building while considering the life cycle of a project, it is critical to include all stages and aspects that may affect the project's cost. In the context of the task, the method of assessing the effectiveness of the management of secure construction (further — MSC) engineering projects using the model of analytical network processes — fuzzy comprehensive evaluation (ANP-FCE) [14].

Machine learning can provide accuracy in calculating and forecasting estimates. For example, the machine learning algorithm "stacking-assembly" for predicting the cost of road construction projects was described in the article Meseret Getnet Meharie [15]. In part, the article proposes an assembly model of stacking, which was developed by automatically and optimally combining three different basic prognostic models: linear regression, base vector method and neural network using the gradient boosting algorithm as a meta-regressor.

To learn a model, machine learning requires a significant amount of data. Machine learning approaches allow the application of various algorithms for forecasting that can account for complicated data connections and trends. Machine learning can also automate the process of estimating costs. This will allow for time and resource savings, as well as a reduction in the possibility of errors connected to manual calculation.

The cost of resources and other factors may change over time. It is therefore important to constantly update the machine learning model with new data so that it reflects the current situation and gives more accurate forecasts.

CONCLUSION

In order to resolve conflicts and use outdated information in the cost formation of the CIW, a single, updated source of information is required that can be used to calculate the limit cost of the infrastructure under analysis. The formation of the current database will enable the use of machine learning methods to determine the estimated value and its forecasting depending on the implementation phases of the investment project (subject to an annual update of pricing).

It is also necessary to develop a cost classifier and methodology for calculating value on European models, taking into account the cost of the building's life cycle, project phasing, cost planning alternatives, and phased approximation of value at the early stages of the project, including with the use of BIM (Building Information Modeling) — methodology used to create and manage digital building models. BIM is able to automate the costing process to generate comparisons with machine learning models to estimate building costs.

In the future, the system will prevent many errors in construction cost calculation, save money early in the development process, and solve the problem of an independent audit of the project's technological and pricing base implemented within the framework of IPA.

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I. V. Kosorukova — literature analysis, problem statement, article concept development, statistical data collection, tabular and graphical representation of results.
S. G. Sternik — literature analysis, comparative analysis of methods for calculating estimates, analysis of estimated pricing abroad, analysis of factors for the formation of the estimated cost of the building.
E. E. Heifets — calculation of the estimated cost of real estate, problems and possible solutions to problems in the system of estimated pricing.

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