

**Bovsunovskaya M.P.
Voronin I.A.**



**Bovsunovskaya
Maria Petrovna,**
Candidate of Economic Sciences,
Associate Professor; Moscow State
University of Civil Engineering
(National Research University)
(MGSU); 26 Yaroslavskoe shosse,
Moscow, 129337, Russian Fed-
eration; ID RSCI: 801918, Scopus
AuthorID: 57192667297, WoS
ResearcherID: AAE-3232-2022,
ORCID: 0000-0003-4036-6069;
bovsunovskayamp@mgsu.ru



**Voronin
Ivan Aleksandrovich,**
deputy director; Scientific and
Production Enterprise "ABC-N";
411 28 Derzhavina St., Novosibirsk,
630091, Russian Federation;
voronin.ivan@abccenter.ru

Cost Management in Industrial Construction Projects through Building Information Modelling

This paper provides a comprehensive analysis of the potential and limitations of using building information modelling (BIM) technology in the context of construction cost management throughout the lifecycle of an investment and construction project. The study covers stages from initial conception and pre-project analysis to facility operation and decommissioning. Emphasis is placed on the challenges of early pre-project stages, such as feasibility studies and conceptual design, which are particularly important when implementing complex industrial projects. The authors highlight a key problem in this area: the lack of specialized, aggregated cost indicators (standards) for industrial construction projects adapted to the specifics of BIM, as well as a shortage of specialized software. This combination significantly reduces the accuracy and validity of initial cost estimates. The paper systematizes the key challenges and benefits that BIM implementation can address in cost engineering at each subsequent stage of a project. The analysis revealed a systemic gap in the current regulatory and methodological framework, which currently does not fully regulate the processes of calculating construction cost estimates at the design stage using digital information models (DIM). Based on the conducted research, a substantiated conclusion is reached regarding the critical need for active development of methodological and regulatory support specifically for the feasibility study and conceptual design stages of industrial facilities. Addressing this challenge is fundamental to achieving end-to-end digitalization of the investment and construction process, increasing the investment attractiveness of projects, and minimizing financial and time risks at all stages of the life cycle. **Keywords:** construction cost, cost engineering, Information modelling, BIM, facility lifecycle, industrial facilities, regulatory framework, feasibility study, conceptual design, digital information model

INTRODUCTION

Russia's state policy on economic digitalization, ambitious infrastructure development plans, and commitment to technological independence increase the importance of adopting information modelling (IM) technology in the construction industry. This process is important for both government agencies and those involved in investment and construction activities. Although the regulatory framework and issues related to domestic software provision have been largely resolved, the practical aspects of using digital information models (DIM) require further study [1, 2].

A key challenge when working with the DIM remains data quality control, including its compliance with regulations, completeness, and consistency. For most users, interacting with the model involves running numerous automated checks: for compliance with regulations, the absence of collisions in geometry, and the sufficiency of attribute information [3].

One promising area for the development of information modelling technology is the use of digital models for calculating and monitoring industrial construction costs. DIM data, in the form of cost indicators and their derivatives, can serve as the basis for implementing cost engineering, which, according to the current GOST¹, includes planning; value, economic, and financial analysis; assessment and audit; control and optimization; and performance,

change, and cost risk management at all stages of the project lifecycle. At the same time, the availability of up-to-date regulatory and methodological materials governing these processes remains critical for cost engineering specialists, particularly with regard to the most underdeveloped aspect — construction cost assessment.

Of all the currently available regulatory documents concerning the application of the information modelling technology, the vast majority address issues of developing the DIM and the interaction of process participants at various stages of the life cycle. However, issues related to determining the cost of construction using the DIM are almost absent from any of these regulatory documents. One such document, approved by Order No. 854/pr of the Ministry of Construction of the Russian Federation dated December 24, 2020, establishes a methodology for determining the cost of work on preparing design documentation containing materials in the form of a digital information model². A similar document applies to the development of projects for the construction of facilities financed by the Moscow budget³. Both documents focus not on the estimated cost of construction, but on the cost

¹ GOST R 58535–2019. National Standard of the Russian Federation. Cost Engineering. Terms and Definitions. Electronic Fund of Legal and Regulatory Technical Documents. URL: <https://docs.cntd.ru/document/1200167735?section=text> (rus.).

² Methodology for determining the cost of work on the preparation of design documentation containing materials in the form of an information model, approved by Order of the Ministry of Construction of Russia dated December 24, 2020 No. 854/pr (as amended). Federal State Information System for Pricing in Construction. URL: <https://fgiscs.minstroyrf.ru/frsn/standard/methodical/ee87485b-4468-4d12-9826-c7905636dbac> (rus.).

³ Methodological recommendations for calculating design costs using information modeling technology, carried out with the involvement of funds from the Moscow city budget MRR-12.1-18, as amended as of August 6, 2021. Electronic fund of legal and regulatory documents. URL: <https://docs.cntd.ru/document/565439796> (rus.).

of design work, i.e., they partially address cost determination at the architectural and construction design stage. The methodology for determining estimated construction costs, approved by Order No. 421/pr of the Ministry of Construction of the Russian Federation dated August 4, 2020, regulates the determination of the developer's costs for maintaining a digital information model during the construction phase⁴. This method, however, focuses on the construction phase and does not address the issue of determining the construction cost, but only the additional costs associated with bringing the digital information model into compliance with the as-built documentation.

At the same time, all existing regulatory and methodological documentation in the field of cost estimation is oriented toward working with so-called flat or 2D construction drawings and their corresponding specifications. For example, the rules for calculating work volumes imply manual calculation of all values, without the use of geometric solvers. Another feature of the existing technology is the dependence of the structure of the cost estimate documentation on the structure of the design solutions, i.e., on how the design solutions are displayed on the sheets of design or working documentation. All design volumes are calculated and included in the specifications in accordance with how the drawings are compiled. The volumes of material resources and, accordingly, the volumes of work are typically calculated separately for each drawing and rounded to significant digits, most often to 2–4 decimal places, depending on the unit of measurement. Such volumes are included in the estimate documents in the same sequence, with the accumulation of the total volume and the formation of the cost as a sum of intermediate rounded values.

Information modelling implies a fundamentally different approach to design solutions. Essentially, all work shifts from drawing-based to element-based. However, with the element-based method of calculating material and labor volumes, final estimates can vary significantly. Consequently, cost estimates can vary by several percent, depending on the design stage and the pricing methodology used.

Despite the apparent fragmentation of approaches to determining construction costs based on the DIM in methodological and regulatory documents at the state level, construction organizations are developing and applying these approaches, as they see high potential for solving a wide range of problems in the field of cost engineering [1, 2]. Let us consider the key stages of industrial construction project implementation, the role of the information modelling technologies in each of them, and their implications for cost determination.

PRE-INVESTMENT STAGE AND CONCEPTUAL DESIGN

At the initial stage, a feasibility study (FS) and a concept for the future facility are developed [4]. The information modelling technologies are used for 3D visualization and preliminary analysis, since creating even simple sketch models helps the client and investors evaluate architectural solutions. At this stage, a cost estimate is also generated using aggregated standards, such as construction cost standards, or data from similar projects. Most of the necessary data can be obtained from a digital information model based on parametric modelling, allowing for cost forecasting

⁴ Methodology for determining the estimated cost of construction, reconstruction, major repairs, demolition of capital construction projects, work on the preservation of cultural heritage sites (historical and cultural monuments) of the peoples of the Russian Federation on the territory of the Russian Federation, approved by order of the Ministry of Construction of Russia dated 04.08.2020 No. 421/pr (as amended). Federal State Information System of Pricing in Construction. URL: <https://fgiscs.minstroyrf.ru/frsn/standard/methodical/10c50a07-101d-493d-bf3e-6bea9208c76d> (rus.).

before detailed design development. However, there are almost no developed solutions for the current stage. At this stage, the task of selecting optimal solutions is typically resolved by comparing options based on energy efficiency, materials, and other parameters, including cost. Using the information modelling technologies at this stage helps avoid costly changes at subsequent stages.

DESIGN

This is the stage of detailed design documentation development, one of the most important for the application of the information modelling technologies. Here, the technology ensures coordination between specialists – architects, designers, and engineers work in a single environment, which reduces the number of collisions [3]. The digital information model allows for almost complete automation of calculations: checking structural loads, engineering system parameters, and their compliance with regulations. At this stage, precise specifications for all material resources and volumetric indicators are also generated [5]. Using modern information modelling systems, it is possible to automatically generate bills of materials and equipment, which requires strict adherence to the requirements for detail and information content of the DIM⁵ [6]. To estimate costs at the design stage, a cost estimation and regulatory framework is applied, using elemental cost estimates or rates depending on the adopted pricing method, such as GSN-2022 or TSN-2001 (Fig.).

Cost data obtained on the basis of the DIM data are downloaded from it in the form of traditional cost estimates and are the basis for calculating the initial (maximum) prices of contracts (agreements) (hereinafter referred to as the IMPC(A)).

CONSTRUCTION

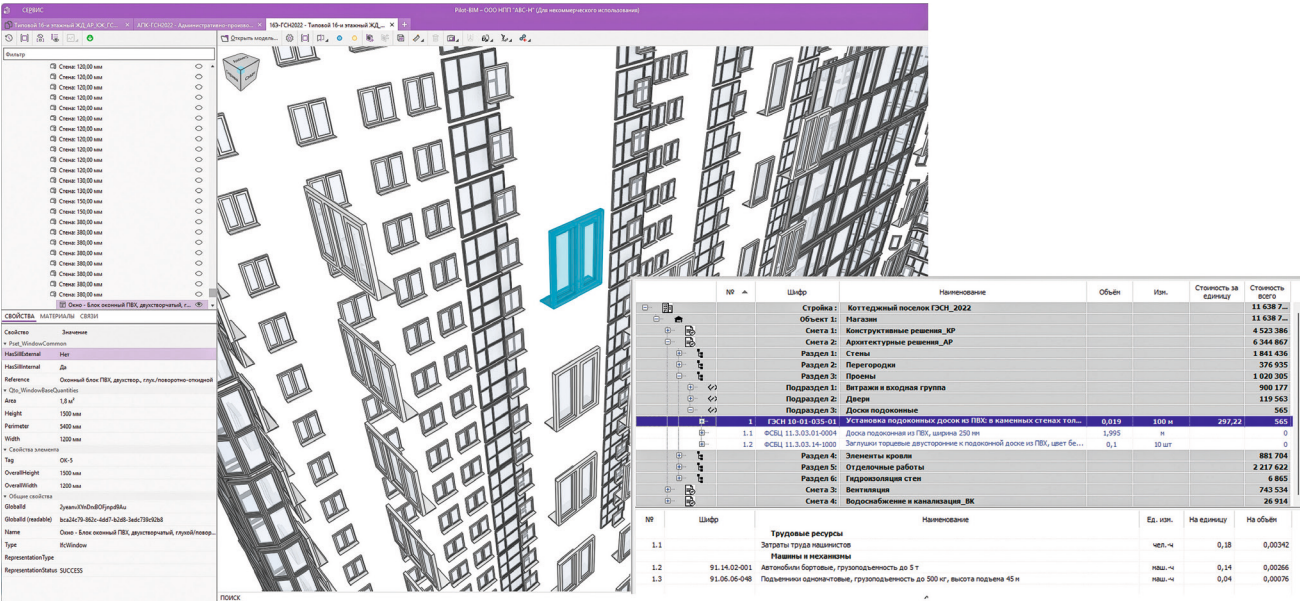
During construction, the information modelling technology (IMT) is most often used for logistics and planning. For this purpose, 4D modelling (time + 3D) is used, which helps optimize the construction and installation schedule and material procurement schedule. In addition to logistics and planning, quality control tasks are also addressed by verifying execution against the design model using laser scanning. IMT is sometimes used during the construction phase to manage construction resources through integration with the construction company's Enterprise Resource Planning (ERP) systems for accounting for labor costs, materials, and equipment. The use of IMT on the construction site reduces the number of reworks by 20–30 % [7, 8].

OPERATION OF THE FACILITY

Once commissioned, the information model becomes the basis for facility management. Using the information model, it's possible to perform maintenance while organizing the storage of data on utilities, repair schedules, and warranties. To optimize operating costs, energy monitoring can be performed by analyzing sensor readings. To address building lifecycle management issues, information modelling technology is now often transformed into the concept of a Digital Twin.

To determine the cost of operating a building, including the cost of routine and major repairs, various approaches are used, based on both standard costing approaches and the recording of actual expenditures incurred during implementation.

⁵ Benklyan S.E. *Levels of detail of elements of the information model*. Portal isicad. 2014. URL: http://isicad.ru/ru/articles.php?article_num=17329 (rus.).



Example of determining the cost of a BIM element (based on the integration of Pilot-BIM and ABC-Estimates software systems). The technology is identical for industrial construction

Determining the cost of an industrial construction project at different stages of the life cycle of an investment and construction project

Life cycle stage	Application of IMT	Problems to be solved	Determination of cost
Pre-investment stage and conceptual design	Analogue object or conceptual model	Concept analysis, visualization. Selection of project options	Formation of the estimated (marginal) cost for similar objects or aggregated indicators based on the DIM (if available)
Design	Design model	Development of design documentation, calculations of building structures	Calculation of the estimated cost of construction with reference to the elements of the DIM
Construction	As-built model	Construction management, logistics, preparation of as-built documentation	Formation of the IMPC(A). Audit, iterative cost changes based on the DIM. Formation of the book value of the asset based on actual data
Operation	Digital twin	Current maintenance of the facility, repairs	Calculation of the cost of maintenance and repairs based on regulatory data and DIM data
Demolition and disposal	Digital twin or simplified design model	Calculation of demolition volumes, planning of materials disposal	Calculation of the estimated cost of demolition and disposal works based on the DIM data

DEMOLITION AND DISPOSAL

At the final stage of a building's lifecycle, the IMT helps plan safe demolition by analyzing building structures to select the optimal dismantling method, as well as taking into account environmental disposal requirements (information about materials enables their effective recycling). In terms of cost determination, demolition and disposal work is, in most cases, similar to the approaches used during construction cost determination.

The tasks solved using the IMT at different stages of an investment and construction project's lifecycle can be summarized in the following table (Table).

IMT transforms all stages of investment and construction projects, ensuring:

- end-to-end digitalization of data — from concept to disposal;
- risk reduction — through early error detection;
- resource savings — time, money, and materials.

However, for maximum efficiency in the application of IMT, it is necessary to develop a regulatory framework⁶ [1, 7] and train qualified personnel who are proficient in interdisciplinary ap-

proaches [2, 9], both in the area of IMT application and in the area of cost engineering.

CONCLUSIONS

The ability to apply an end-to-end approach to determining the cost indicators of an industrial construction project based on the DIM at various stages allows for a new approach to construction cost estimation. This approach uses DIM data for phased cost justification, linking it to model elements and increasing the accuracy of the estimate depending on the model's content and development. It also allows for iterative auditing and cost adjustments based on the impact of internal and external environmental factors and the ongoing implementation objectives of the investment and construction project. The resulting information models with assigned costing properties can serve as the basis for generating aggregated indicators of industrial construction costs, making the investment justification stage more transparent and the cost justified at this stage. Due to insufficient regulatory and methodological support for using DIM to generate cost estimates at various stages of the project lifecycle, it is necessary to develop detailed methods for determining construction costs using IMT, as well as the corresponding software tools.

⁶ Urban Development Code of the Russian Federation of December 29, 2004, No. 190-FZ. URL: http://www.consultant.ru/document/cons_doc_LAW_51040 (rus.).

REFERENCES

1. Gudz S.V. Problems of Integrating of Estimated Pricing in Information Modelling Technologies. *Stolypin Annals*. 2023; 5(4):3. EDN WAZRY. (rus.).
2. Nikitina E.A. Implementation of BIM-technologies in estimate documentation. *Engineering Journal of Don*. 2020; 12(72):1-9. EDN CPOSOX. (rus.).
3. Talapov V.V. BIM Fundamentals: Introduction to Building Information Modeling. Moscow, DMK Press, 2011; 391. EDN SUGOFL. (rus.).
4. Chernova P.A., Bovsunovskaya M.P. Improvement of methods for determining the cost of design solutions at early stages of investment and construction projects realization. *Real Estate: Economics, Management*. 2023; 4:21-30. DOI: 10.22337/2073-8412-2023-4-21-30. EDN DYXAF. (rus.).
5. Bovsunovskaya M. Development of a cost controlling system for an investment and construction project. *E3S Web of Conferences : 24th International Scientific Conference on Construction the Formation of Living Environment. FORM 2021*. Moscow, EDP

- Sciences, 2021; 05048. DOI: 10.1051/e3sconf/202126305048. EDN PEPOZZ.
6. Sedov L.I. Methods of similarity and dimensionality in mechanics. Moscow, Nauka, 1977; 438. URL: <https://search.rsl.ru/ru/record/01007694789> (rus.).
7. Voronin I.A., Izatov V.A., Purs G.A. Requirements of information modeling technologies for the estimate and regulatory base of the Republic of Belarus. *Construction and pricing*. 2021; 3(47). URL: <https://rsc.by/journal/stroitelstvo-i-czenoobrazovanie-2021-N3-speczvypusk> (rus.).
8. Lukmanova I.G., Ukhalkin E.V. Activation of Implementation of Information Modelling Technologies in the Russian Construction Industry. *Vestnik MGSU*. 2023; 18(12):2004-2014. DOI: 10.22227/1997-0935.2023.12.2004-2014. EDN UXWZSH. (rus.).
9. Purs G.A., Izatov V.A., Voronin I.A. Comparative analysis of the functionality of API BIM systems from the standpoint of economic tasks. *Construction and pricing*. 2021. No. 5 (49). URL: <https://rsc.by/journal/stroitelstvo-i-czenoobrazovanie-2021-N5> (rus.).

Стоимостный инжиниринг в реализации проектов промышленного строительства с применением технологии информационного моделирования

В данной статье проводится комплексный анализ возможностей и ограничений применения технологии информационного моделирования (ТИМ/BIM) в контексте управления стоимостью строительства на этапах жизненного цикла инвестиционно-строительного проекта. Исследование охватывает этапы — от первоначального замысла и предпроектного анализа до эксплуатации и вывода объекта из использования. Акцент делается на проблематике ранних, предпроектных стадий, таких как технико-экономическое обоснование (ТЭО) и концептуальное проектирование, особенно значимых при реализации сложных промышленных объектов. Авторы отмечают ключевую проблему этой сферы: отсутствие специализированных укрупненных стоимостных показателей (нормативов) для объектов промышленного строительства, адаптированных под специфику ТИМ, а также дефицит специализированного программного обеспечения, что в совокупности приводит к значительному снижению точности и обоснованности первоначальных стоимостных оценок.

В работе систематизированы ключевые задачи и преимущества, которые позволяют решить внедрение ТИМ в области стоимостного инжиниринга на каждой последующей стадии проекта. В результате анализа выявлен системный пробел в современной нормативно-методической базе, которая на сегодняшний день не в полной мере регламентирует процессы формирования сметной стоимости строительства на этапе проектирования с применением данных цифровых информационных моделей (ЦИМ).

На основании проведенного исследования делается обоснованный вывод о критической необходимости активного развития методического и нормативного обеспечения именно для этапов ТЭО и концептуального проектирования промышленных объектов. Решение этой задачи является фундаментальным условием для достижения сквозной цифровизации инвестиционно-строительного процесса, повышения инвестиционной привлекательности проектов и минимизации финансовых и временных рисков на всех этапах жизненного цикла.

Ключевые слова: стоимость строительства, стоимостный инжиниринг, информационное моделирование, BIM, жизненный

ный цикл объекта, промышленные объекты, нормативная база, ТЭО, концептуальное проектирование, цифровая информационная модель

СПИСОК ИСТОЧНИКОВ

1. Гудзь С.В. Проблемы интеграции сметного ценообразования в технологии информационного моделирования // Столыпинский вестник. 2023. № 5 (4). С. 3. EDN WAZRY.
2. Никитина Е.А. Внедрение BIM-технологий в сметную документацию // Инженерный вестник Дона. 2020. № 12 (72). С. 1–9. EDN CPOSOX.
3. Талапов В.В. Основы BIM: введение в информационное моделирование зданий. М.: ДМК Пресс, 2011. 391 с. EDN SUGOFL.
4. Chernova P.A., Bovsunovskaya M.P. Improvement of methods for determining the cost of design solutions at early stages of investment and construction projects realization // *Real Estate: Economics, Management*. 2023. No. 4. Pp. 21–30. DOI: 10.22337/2073-8412-2023-4-21-30. EDN DYXAF.
5. Bovsunovskaya M. Development of a cost controlling system for an investment and construction project // *E3S Web of Conferences: 24th International Scientific Conference on Construction the Formation of Living Environment. FORM 2021*. Moscow, EDP Sciences, 2021. P. 05048. DOI: 10.1051/e3sconf/202126305048. EDN PEPOZZ.
6. Седов Л.И. Методы подобия и размерности в механике. М.: Наука, 1977. 438 с. URL: <https://search.rsl.ru/ru/record/01007694789>
7. Воронин И.А., Изатов В.А., Пурс Г.А. Требования технологического информационного моделирования к сметно-нормативной базе Республики Беларусь // *Строительство и ценообразование*. 2021. № 3 (47). URL: <https://rsc.by/journal/stroitelstvo-i-czenoobrazovanie-2021-N3-speczvypusk>
8. Лукманова И.Г., Ухалкин Е.В. Активизация внедрения технологий информационного моделирования в российской строительной отрасли // *Вестник МГСУ*. 2023. № 18 (12). С. 2004–2014. DOI: 10.22227/1997-0935.2023.12.2004-2014. EDN UXWZSH.
9. Пурс Г.А., Изатов В.А., Воронин И.А. Сравнительный анализ функционала API BIM-систем с позиций экономических задач // *Строительство и ценообразование* 2021. № 5 (49). URL: <https://rsc.by/journal/stroitelstvo-i-czenoobrazovanie-2021-N5/>

Об авторах: **Бовсуновская Мария Петровна** — кандидат экономических наук, доцент; **Национальный исследовательский Московский государственный строительный универ-**

ситет (НИУ МГСУ); 129337, г. Москва, Ярославское шоссе, д. 26; ПИНЦ ID: 801918, Scopus AuthorID: 57192667297, WoS ResearcherID: AAE-3232-2022, ORCID: 0000-0003-4036-6069; bovsunovskayamp@mgssu.ru;

Воронин Иван Александрович — заместитель директора; **ООО Научно-производственное предприятие «АВС-Н»**; 630091, г. Новосибирск, ул. Державина, д. 28, оф. 411; voronin.ivan@abccenter.ru.

For citation: Bovsunovskaya M.P., Voronin I.A. Cost Management in Industrial Construction Projects through Building Information Modelling. *Real Estate: Economics, Management*. 2025; 4:24-28.

Для цитирования: Бовсуновская М.П., Воронин И.А. Cost Management in Industrial Construction Projects through Building Information Modelling // Недвижимость: экономика, управление. 2025. № 4. С. 24–28.

