UDC 334.024

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A study of risks borne by participants in investment and construction projects AMID the introduction of BIM technologies

Building information modelling (BIM) is a key area of construction digital transformation. Currently, the construction industry is getting ready for the mandatory application of BIM in the course of implementation of construction projects co-funded by the government. To determine the barriers, preventing the introduction of BIM, a study was conducted among participants of investment and construction projects to identify the risks of introducing BIM and analyze the risks in the context of the scope of activities conducted by the respondent's employer. The study was focused on investment and construction enterprises willing to introduce BIM. The source data were collected using the polling method (the questionnaire survey). The survey involved 180 respondents — representatives of investment and construction companies, including developers, designers, customers, investors, state and municipal institutions, etc. The study revealed such major risks as the unpreparedness of contractors to use information models (50 %), the risk of lower corporate efficiency during the period of implementation and adaptation of BIM (54 %), and the unpreparedness of the state (its representatives, authorities and government agencies) (48 %). The analysis of respondents' answers, broken down by the scope of corporate activities, proved a correlation between the scope of corporate activities, conducted by the respondent's employer, and the significance of risks. This can be explained by corporate functions and interaction with partner organizations.
Keywords: *construction, building information modelling, investment and construction project, risks, survey*

Introduction of building information modelling (BIM) is the most important focus of digital transformation in the construction industry [1]. According to various sources[1] [2–4], BIM allows reducing construction time and costs both at the construction stage and during operation; it boosts the economic efficiency of an investment and construction project, etc. Given the share of construction in the Russian economy (its GDP share is 5.6 %), construction efficiency improvement can have a substantial economic effect throughout the country; it can improve the efficiency of the budgetary funding of investment and construction projects.

Hence, gradual introduction of BIM in Russia is supported by the federal government. Since 2014, the spread of BIM has enjoyed consistent support. Since 2022, pursuant to Decree No. 331, issued by the Government of the Russian Federation on March 5, 2021, all capital construction projects, co-funded by the state, use BIM on a mandatory basis. However, for a number of reasons, including the unpreparedness of the construction industry, as well as some external factors, such as economic sanctions against Russia and the exit of several major BIM software developers from the Russian market, the introduction of this requirement was postponed for one year. At the same time, a study of obstacles and risks of BIM implementation, to be conducted among participants of investment and construction projects, remains relevant. The federal government and the professional community believe that the identification of such risks and obstacles can support corporate governance, reduce the significance of such risks and help to overcome them in the course of time. The authors of the article conducted a study, aimed at identifying the risks of BIM implementation among participants of investment and construction projects, and analyzed these risks in the context of each respondent's scope of activities. The questionnaire method was used to collect the source data for the subsequent analysis[2]. 180 respondents took part in the survey, all were representatives of investment and construction companies engaged in various types of activities. The sampling structure is presented in Table 1.

A substantial share of respondents represented design companies and educational institutions (in total, more than 50 % of the respondents). The survey was conducted during the First United Eurasian Congress of the BIM Society. It demonstrated high awareness of respondents' of BIM development problems in Russia. Data were collected via online and paper questionnaires. Sampling can be characterized as spontaneous.

Respondents were asked about the main risks of BIM implementation. A respondent could give several answers to each question or choose to give an answer of his/her own. The authors used the results of Russian[3, 4] [5–7] and foreign studies [8–11] to interpret the responses.

The breakdown of respondents' answers is presented in Fig. 1.

Results of the study of problems of information modelling technologies implementation by Russian

1 Concurator assessment of the use of BIM technologies in construction. Study report. 2016. URL: http://concurator.ru/information/bim-value/

2 Results of the study of the problems of introducing information modeling technologies in investment and construction projects of Russian companies: report. Moscow, MGSU; 2022. URL: https://mgsu.ru/news/2022/Otchet_rez_issled_problem_TIM.pdf.

3 The level of use of BIM technologies in Russia. Study report. 2017. URL: http://concurator.ru/information/bim_report

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Table 1. Survey sampling structure

Type of corporate activity	Share, %	Type of corporate activity	Share, %
Architect	1.7	Public authority	2.8
Designer	27.2	Educational institution	27.2
General contractor	2.8	BIM software developer	6.7
Builder	3.9	Manufacturers and suppliers of construction products and equipment	2.8
Government/Mnicipal institution	8.3	Construction owner's representative	4.4
Developer	5.6	Operating organization	1.7
Investor	2.2	Other entities	2.8

Source: Results of the study of problems of information modelling technologies implementation by Russian companies in the course of delivery of investment and construction projects: a report. Moscow, NRU MGSU, 2022 [6].

companies in the course of delivery of investment and construction projects: report. Moscow, NRU MGSU, 2022[2].

More than a half of the respondents (59 %) emphasized the unpreparedness of contractors to use information models as the main risk of BIM implementation and about a half (48 %) specified the unpreparedness of the state (representatives of the state, government authorities and organizations). The risk of implementation associated with corporate effectiveness reduction during the extensive period of implementation and adaptation of BIM was mentioned by 54 % of respondents. Other risks, being less substantial, still matter. 8 % of the respondents chose the answer that read as "an increase in the competitiveness of a construction company will not be a direct consequence of introduction of information modelling technologies". In addition to these risks, respondents chose personnel and financials-related risks.

BIM implementation risks were analyzed by the respondents on the basis of the survey results. Towards this end, all respondents were divided into groups depending on the types of activities (to make the data suitable for analysis), or the functions performed by the companies:

- the group of architects and designers was titled as "designers" with a share of 28.9 % in the sampling;
- general contractors, contractors, developers, and customer's representatives were titled as "builders" with a share of 11.1 %;
- state/municipal institutions and authorities were titled as "the state" with the share of 11.1 %;
- developers and investors were titled as "investors" with the share of 7.8 %;
- representatives of educational institutions and software developers were "universities" and "software developers". Other respondents were excluded from the analysis, as their share in the sampling was small and it did allow for any reasonable conclusions about the influence of corporate activities on major risks that could accompany BIM implementation.

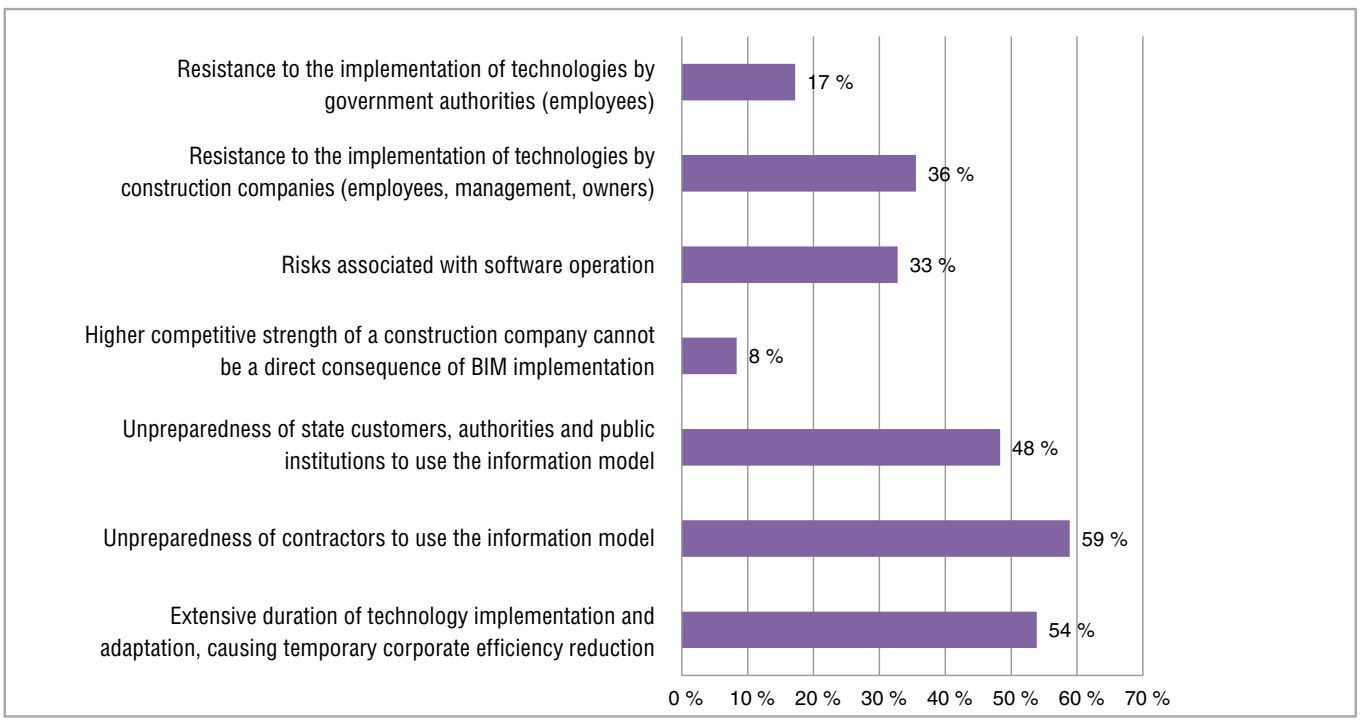

Fig. 1. Principal risks of BIM implementation (based on the results of the survey)

Results of the analysis of the impact made by each type of respondent's company on major risks accompanying BIM implementation are presented in Table 2.

The analysis showed that the nature of the respondent's corporate activity influences his opinion in terms of significance of BIM implementation risks. For example, respondents from the "state" group tend to assess the risk of implementation and adaptation, causing a temporary reduction in the effectiveness of corporate activities as substantially higher than construction companies (75 % and 42 to 64 %, respectively). The unpreparedness of contractors to use information models is most often chosen as a risk by "software developers" (83 %), "investors" (71 %), and "universities" (61 %). Unpreparedness of representatives of state, government authorities and state institutions to use information models was most often chosen by designers (61 %). However, representatives of the "state" group also recognize this risk as highly substantial (55 % of cases).

Risks associated with the correct operation of software were mentioned by "universities", "the state" (45 % each), and "designers" (37 %), responding from their practical experience. Representatives of corporate investors as well as software producers did not choose this risk: both groups assessed the risk at 0 %. It is likely that investors have no experience in dealing with this risk. Software vendors may underestimate the significance of errors in BIM software. In this case, it is fair to pay attention, first of all, to the opinion of designers, being the respondents who have much experience in the practical application of information models.

Respondents chose differing answers to the question about the risk of resistance to the introduction of technology by construction companies (employees, management, owners): this risk was considered as the least substantial by "designers" (27 %), while "software developers" chose it in 67 % of cases.

The group "state" (10 %) hardly agreed with the fact that government authorities and management (employees) resisted the introduction of this technology, and other groups of respondents also mentioned this risk rather rarely (from 16 to 25 %).

It is interesting to note that "software developers" (0 % of respondents from this group mentioned this risk) disagreed with the statement that an increase in the competitiveness of a construction company would not be a direct consequence of the implementation of BIM, which had a generally low value for the entire sampling. In our opinion, this is related to the functions performed by respondents in this group which probably concentrates on the fact that the use of such tools is bound to an increase in the efficiency of companies. At the same time, representatives of other groups of respondents, while understanding the importance of the tool itself, did not forget that its effective use requires changes in business processes, retraining or hiring personnel, etc. In the case of poorly organized processes of software application, the effectiveness of the tool may be reduced.

Hence, the analysis of the findings has shown that the scope of corporate activities affects the identification of factors of BIM implementation as risks. Information about the respondents' opinion about the significance of certain risks can be used by the authorities and management, professional associations and communities in the targeted work focused on risk reduction.

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Table 2. Assessment of BIM implementation risk significance by respondent groups

Risks/Respondent Group	Universities, %	State, %	Investors, %	Builders, %	Designers, %	Software developers, %
Duration of implementation and adaptation of technology, causing a temporary reduction in the productivity of employees and a general reduction in the corporate efficiency	43	75	64	50	53	42
Unpreparedness of contractors to use information models	61	50	71	50	55	83
Unpreparedness of representatives of the state, government authorities and public institutions to use information models	43	55	57	42	61	42
Higher competitive strengths of a construction company will not be a direct consequence of BIM implementation	10	10	14	8	6	0
Risks associated with software	45	45	0	17	37	0
Resistance to BIM implementation by construction companies (employees, management, owners)	47	30	29	42	27	67
Resistance to BIM implementation by government authorities (employees)	22	10	21	25	16	17

Source: compiled by the authors.

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Исследование рисков участников инвестиционно-строительных проектов в условиях внедрения технологий информационного моделирования

Технологии информационного моделирования (ТИМ) являются ключевым направлением цифровизации строительства. В настоящее время в строительной отрасли идет подготовка к введению требования об обязательном применении ТИМ на объектах с привлечением государственного капитала. Для определения барьеров внедрения ТИМ проведено исследование, направленное на выявление рисков внедрения ТИМ среди участников инвестиционно-строительных проектов и анализ рисков в разрезе вида деятельности организации респондента. Объектом исследования стали предприятия инвестиционно-строительной сферы, заинтересованные в вопросах внедрения ТИМ. Первичные данные для анализа были собраны с применением метода опроса (анкетирования). В опросе приняли участие 180 респондентов — представителей компаний инвестиционно-строительной сферы различных видов деятельности, в том числе девелоперов, проектировщиков, заказчиков, инвесторов, государственных и муниципальных учреждений и т.д. В ходе исследования выявлено, что наиболее значимыми рисками являются: неготовность контрагентов работать с использованием информационной модели (50 %), риск снижения эффективности деятельности организации в течение длительного периода внедрения и адаптации ТИМ (54 %), а также неготовность со стороны государства (государственных заказчиков, органов власти и госучреждений) (48 %). Анализ ответов респондентов по видам деятельности организаций показал, что существует зависимость между видом деятельности организации респондента и значимостью рисков. Это объясняется особенностями функций, выполняемых организациями различных видов деятельности, а также спецификой взаимодействия с контрагентами.

***Ключевые слова**: строительство, информационное моделирование здания, инвестиционно-строительный проект, риски, обследование*

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For citation: Kisel T.N., Mishlanova M.Yu., Galeev K.F. A study of risks borne by participants in investment and construction projects AMID the introduction of BIM technologies. *Real estate: economics, management*. 2022; 4:37-40.

Для цитирования: *Кисель Т.Н., Мишланова М.Ю., Галеев К.Ф.* A study of risks borne by participants in investment and construction projects AMID the introduction of BIM technologies // Недвижимость: экономика, управление. 2022. № 4. С. 37–40.