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IMPLEMENTATION OF BIM TECHNOLOGIES IN THE MANAGEMENT OF MULTI-APARTMENT BUILDINGS DURING THE OPERATION PHASE

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Abstract: The paper discusses the main aspects of implementing BIM technologies in the management of multi-apartment buildings. It highlights the features of implementing the system, including the stages of creating a digital model of the building, requirements for personnel, and specific skills. The advantages and opportunities that arise in the management process of multi-apartment buildings with information modeling technologies are noted. Specifically, it simplifies processes such as document storage and transmission, organization of building operations, current repairs of buildings and structures, and more. The prospects for the implementation of information technologies in the housing and utilities sector in the Russian Federation are already outlined: by 2023, developers are required to use these technologies when planning and constructing multi-apartment buildings. The government is implementing a series of systemic initiatives and measures aimed at the digitalization of multi-apartment building management, supporting the development of the sector towards a service model, and ensuring comfortable living conditions for citizens. To support these initiatives, it is necessary to unify requirements for services, standards for data collection, transmission, processing, and access, and to clarify the rules of interaction among participants, taking into account the active implementation of digital technologies in practice. The primary principle of digitalization should be economic feasibility. The implementation of digital technologies should provide real value for developers, management organizations, owners of residential and non-residential premises, and authorities. To achieve digitalization results, it is necessary to create conditions that stimulate the efficiency of interaction between subjects involved in the digitalization of multi-apartment building management. In particular, it is required to establish requirements for the implementation of information technologies at the legislative level.

Keywords: BIM technologies, information modeling technologies, digitalization of housing and utilities sector, digital model, management organization, multi-apartment building

ВНЕДРЕНИЕ BIM-ТЕХНОЛОГИЙ В УПРАВЛЕНИЕ МНОГОКВАРТИРНЫМИ ДОМАМИ НА ЭТАПЕ ЭКСПЛУАТАЦИИ

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Аннотация: Рассмотрены основные аспекты внедрения BIM-технологий в управление многоквартирными домами. Показаны особенности внедрения системы, в том числе - этапы создания цифровой модели дома, требования к кадровому персоналу и специальным навыкам. Отмечены преимущества и возможности, которые появляются в процессе управлении многоквартирным домом при наличии технологий информационного моделирования. В частности, упрощаются процессы хранения и передачи документов, организация эксплуатации конструкций здания, текущего ремонта зданий и сооружений и др. Перспективы внедрения информационных технологий в сферу жилищно-коммунального хозяйства в Российской Федерации уже намечены: в 2023 году застройщики должны использовать эти технологии при планировании и постройке многоквартирных домов. Государство реализует ряд системных инициатив и мероприятий, направленных на цифровизацию управления многоквартирными домами, поддержку развития отрасли в направлении сервисной модели и обеспечения граждан комфортными условиями проживания. Для поддержки этих инициатив необходимо провести унификацию требований к услугам, стандартам сбора, передачи, обработки и доступа к данным и работы с ними, уточнить правила

взаимодействия участников с учетом активного внедрения цифровых технологий в практику. При этом основным принципом цифровизации должна стать экономическая целесообразность. Внедрение цифровых технологий должно иметь реальную ценность и для застройщиков, и для управляющих организаций, и для собственников жилых и нежилых помещений, и для органов власти. Для достижения результатов цифровизации необходимо создать условия, стимулирующие повышение эффективности взаимодействия между субъектами цифровизации управления многоквартирными домами. В частности, на законодательном уровне требуется установить требования по внедрению информационных технологий.

Ключевые слова: BIM-технологии, технологии информационного моделирования, цифровизация жилищно-коммунального хозяйства, цифровая модель, управляющая организация, многоквартирный дом

INTRODUCTION

Digitalization of the housing and utilities sector (HUS) is one of the priorities of the Russian Federation. An example is the approval by the Government of the Russian Federation to use information modeling technologies (BIM) in the construction and operation of buildings, including multi-apartment buildings (MAB). The Government Decree of December 20, 2021, No. 3719-r contains a plan aimed at creating conditions for the implementation of BIM in the construction industry and improving the quality of construction projects [1]. Digitalization of HUS allows integrating interaction and reporting processes at all management levels into a single information field. This allows for the optimal allocation of common resources, including natural resources, to improve the overall quality of life in the country. In this regard, studying new technologies that can improve the management system of HUS in general and MAB in particular becomes especially relevant.

In relation to buildings, this is an approach to their construction, maintenance, and repair, which involves the collection and processing of comprehensive data about the building in digital format. The authors of the work consider that building information modeling is a modern innovative approach to designing, constructing, and operating buildings [2]. Technically, building information modeling represents a complex process based on the use of accurate and coordinated data at all stages – from the development of the building concept to its construction and commissioning. The theoretical analysis revealed trends in the construction sector and the directions of BIM use. The authors note that such technologies are most often used in the construction of stadiums in Moscow, St. Petersburg, Saransk, Volgograd, Nizhny Novgorod, Samara, Sochi, and Kazan. This is primarily due to the complexity of the objects and social responsibility since stadiums accommodate from 20,000 people and more, hence the increased responsibility for inadequate structures and risks associated with the safety of life and health of people.

The new Volgograd Arena stadium was built using BIM technologies due to the technical complexity of the object. 3D models of structurally complex elements were created, and the data from these models were directly transferred to the manufacturer of the structural elements. The oval Mordovia Arena stadium was characterized by a technical feature of 88 interconnected consoles 40 meters high with a span of 49 meters. Thanks to BIM, a solution was quickly found, and the stadium was built without problems. The Skolkovo Research Center was also built using digitized architectural structures, allowing for all the structural features of the future building to be considered.

As can be seen, specialized literature mainly identifies sports facilities or buildings and does not contain examples of how BIM helps in the management of MAB. Consequently, this issue is insufficiently studied, although some authors show interest in it [3].

MATERIALS AND METHODS

Building information modeling (BIM) is essential for managing the maintenance, current, and capital repairs of MABs, as well as for analyzing the operational characteristics of buildings [4]. The operational model (AIM) of an object contains complete information about the object [Figure 1], and this information can be used in various activities at the operation stage [5]. Moreover, the BIM model provides accurate construction data and can be integrated with other tools that perform energy efficiency analysis, schedule replacements, and maintenance of engineering systems [6]. Such a model can be considered an integrated set of technologies that facilitate building management throughout its life cycle [7].

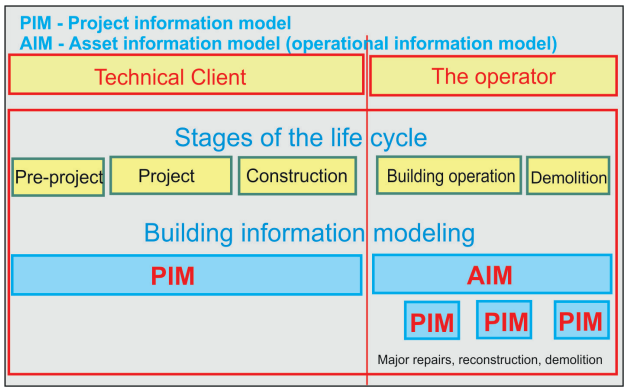

Figure 1. Stages of the Object's Life Cycle

Thus, the AIM information model has the potential to conduct maintenance and repair work on the building's engineering structures and systems more efficiently [18].

V.T. Talapov specifies [8] that BIM is aimed at calculating and modeling construction work and erecting new buildings, but it also finds application in housing and utilities management. In particular, the author shows how this technology can be applied to achieve the following goals:

1. The ability to model changes in the building's structure in case certain circumstances arise (works in non-residential premises by private property owners-entrepreneurs who may make adjustments to the structures);
2. Designing the re-equipment of the building with new engineering equipment, bringing its operational characteristics to the modern level of requirements (this situation is especially relevant for long-operated houses where heating equipment, particularly the piping system, has not been changed for many years, mainly due to lack of funding or the unwillingness of the managing organization (MO) to allocate funds for this, as the budget of such an event may increase during the equipment replacement process);
3. Monitoring the current state of the building (this process is currently outdated in the traditional view, as inspections and checks, as well as rounds by MO engineers, are conducted irregularly, and most often only in response to owners' complaints and inspections by municipal authorities);
4. Properly operating existing facilities (this is possible, for example, with the help of a digital model of the building, which clearly shows all the features of architecture, water supply, heating, and other engineering systems) (Figure. 2).

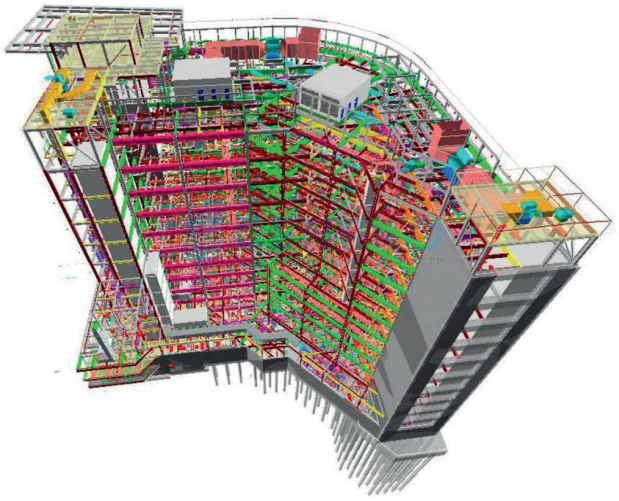

Figure 2. Information Model of Engineering Systems of Multi-Apartment Buildings

5. Managing the building's energy consumption, such measures can benefit both residents and society [9].
6. BIM provides accurate data about the object and can be integrated with other tools that perform energy efficiency analysis, resulting in reduced resource consumption costs [10].

Maintenance and current repairs of buildings and structures are very important and quite costly (considering the operating periods) types of day-to-day activities for managing organizations. This is the main type of work with the building during its service life, and here information modeling allows the listed tasks to be carried out timely and efficiently, minimizing overall costs.

BIM technologies can facilitate communication between various stakeholders involved in the management of multi-apartment residential buildings (MKB), such as building owners, managers, and tenants, by providing a common platform for sharing information and collaborating on building-related tasks. Thus, the information model can be applied for digital calculations and conducting financial activities between the managing organization and the owners of non-residential premises, who must pay monthly for maintenance and repairs. In practice, this process occurs "the old-fashioned way," by delivering paper payment receipts from the representative of the managing organization to the tenant's location. A digital version of this process would simplify the procedures for delivering receipts and generating reports.

One of the most important tasks in managing MAB is document management. The advantages provided by BIM technologies in managing MAB are that with their implementation, there is no need to maintain a paper archive with all the documentation about the object. The problem of paper archives is inherent in the entire bureaucratic system, and especially in the housing and utilities sector. Many managing organizations still store archives in folders without proper storage conditions, which affects their preservation.

Experts believe that the digital model of the house must also be included in the electronic technical passport of the house. This will allow the managing organization to control the state of all communications and load-bearing structures of the house, and the owners to see the real picture of what the managing organization has done in terms of building operation, preparation for the winter period, etc. [11].

Another aspect referred to by R.I. Surzhikov is the guarantee of the preservation of all executive and other documentation. Undoubtedly, when transferring management rights of the MAB, documentation is lost or deliberately damaged to hide disadvantages, risks, and deficiencies. With a digital model of the document archive, such situations will no longer concern companies entering the right to manage the MAB [12].

BIM allows for the creation of an accurate digital model of the MAB, which includes information about every part of it, from the foundation and walls to engineering systems and equipment. This facilitates the work of survey engineers, as they can easily access information about the building without the need to be physically present on site. Moreover, this approach reduces the time required for engineering surveys, as the information about the building is available in one digital place. It also helps reduce the costs of engineering surveys since there is no need for constant repeat trips to the site [9]. Overall, this optimizes the work of survey engineers, eliminating bureaucratic procedures.

Several authors address the topic of organizing new processes based on BIM: new technologies cannot simply be introduced into the housing and utilities sector [14], which is characterized by specific processes that have not changed for years. Thus, a number of authors [15] note the importance of personnel potential and the availability of special knowledge. To implement an operational information model of a multi-apartment residential building, it is necessary to

have appropriate personnel. The authors divide the process into two parts: in the first part, the building is designed and put into operation, in the second, the object continues to be operated by the specialists of the managing organization or the homeowners' association (HOA). The first part requires specialists such as BIM manager, BIM master, BIM coordinator, and BIM technician. In the subsequent operation of the object, the specialists should be provided by the staff of the managing organization or other controlling organizations for the operational information model of the multi-apartment residential building (FIM) [16]. These specialists include:

- FIM manager (specialist in modifying the 3D model and its implementation during operation);
- FIM dispatcher (specialist operating the building based on the 6D model: 3D model + time + information + operation);
- FIM engineer (specialist in developing engineering transformations of the building, such as major repairs, reconstruction, restoration, implementation of new technologies, and engineering networks) [15].

The application of BIM technologies in managing MAB in Russia is still at an early stage, and full-scale implementation will require investments in infrastructure and personnel training for interested parties.

K.V. Borodulin raises an important topic in his article [17] about the implementation of BIM in the management of MAB. The author envisages the implementation of information modeling in three stages:

1. Formation of the project team and development of the regulatory framework.
2. Collection and analysis of information about the object and organization.
3. Conducting laser scanning of the object and creating the information model.

Digitization of the housing and utilities sector faces specific problems, such as low demand for quality IT solutions: lack of initiative from housing and utilities organizations, resistance from managing organizations and HOAs, and lack of a competitive environment [18, 19]. However, the advantages of BIM make them a promising tool for increasing the efficiency of MAB management. There are already promising steps in this direction. For instance, the Ministry of Construction has mandated developers to implement BIM even at the foundation and planning stages. In 2023, this work was conducted in the construction of MAB, and in 2024, the technologies will be implemented in the construction of individual housing.

CONCLUSIONS

BIM technologies can help optimize the management of multi-apartment buildings by providing a comprehensive digital building model that can be used for monitoring and controlling various aspects of building operation, such as energy consumption, maintenance, and repairs. Moreover, BIM technologies will definitely help reduce costs associated with building maintenance and repairs by providing a more accurate and detailed understanding of the building's condition and needs.

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