Use of modern technology of information modeling in capital construction object life cycle management

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Abstract. The urgency of the topic is determined by the problems and prospects for the development of information modeling technology in the Russian construction industry. Modern information modeling technologies provide new opportunities in assessing the efficiency of project management. The main problems related to the implementation of the building information modeling system at the operational stage have been described and characterized. The paper shows that information modeling technologies, being the foundation of digital construction, allow creating an integrated informational space in a single place and inseparable in time of use, as well as collecting and systematizing all object data, and making an information management process as efficient as possible.

1. Introduction

Construction is one of the leading sectors of the Russian economy and is a dynamic and at the same time rather complex system in the current economic situation that needs permanent control due to the continually changing state of an object throughout its life cycle.

The active development of technically sophisticated complexes and engineering systems for capital construction, the transition to innovative technologies for the construction of modern industrial buildings in recent decades has led to a rapid penetration of new approaches based on systematic research methods [1-5].

Today, capital project design, construction and operation processes all over the world undergo serious changes related to economy digitalization. Transformation of industrial processes into digital format is on the agenda in many sectors of the economy [6-9]. The program of "The Digital Economy of the Russian Federation", approved in July 2017, identified several industries, among which construction industry has been excluded [10]. However, it is just a matter of time, and in the nearest future digital construction will obviously become a separate sector to be focused on in the large program. This means that a detailed plan will be developed, thus providing further construction digitalization and giving a "new breath" to the Russian national program on transition to building information modeling technologies (BIM).

The purpose of this study is to form a certain vision, evaluate modern conditions for the development of building information modeling technology and justify the use of an information model.
in the building management process, which is filled with data from the very beginning of the capital construction object life cycle.

2. Materials and Methods
Information technology is a process of collecting, integrated processing of all information about an object with all its interconnections and further transferring of structured data for achieving desired goals. An information in design area means both the initial data and the result of such design. There has been one problem raised over the years in Russia on the rational and effective use of buildings. The debate on this topic was heated up after BIM development and the idea that the BIM-information obtained during the object's life cycle can help to improve the efficiency of real estate management (FM – Facility Management).

Stage of operation is the longest stage in the object's life cycle and may continue for 50 years or more. Moreover, it is the main contribution to the cost of the object's life cycle. According to calculations, the cost of the life cycle is five to seven times higher than the cost of initial investments and three times more than the cost of construction itself [11].

There is a tremendous economic and ecological need for the management of newly built and already existing real estate objects to be carried out in the most efficient way.

Previously performed foreign studies of BIM potential to improve the efficiency of building management, as well as the study of barriers preventing its use, have shown that this potential comes out from the improvement of currently existing manual information transfer processes, for example, as-built (or post completion) documentation. Whereby, it was noted that such technology also improves data accuracy and increases management efficiency in terms of access rate to project data. Insufficient studies became evident on the basis of realistic examples, especially in relation to existing buildings, despite the fact that new constructions make a minor percentage of the total building stock [12]. The obtained results testify the BIM value in terms of increasing the efficiency of FM-orders, as well as the accuracy of geometric information records.

Facilities Management (FM) is a generic term that brings together a wide range of functions related to real estate and its user, as well as being favorable for organizations and its employees as a whole. FM is global by its nature and covers everything from real estate and financial management to facility and sanitary maintenance. Government authorities from many countries of the world recognized the inefficiency of applied processes, which generally influence on the construction industry, and suggested to use building information modeling as a strategy addressed at solving problems in the decreasing productivity in this area [13,14].

Building Information modeling in real estate management is the process of generating and managing information about a facility during its entire life cycle. For example, the UK government, as one of the leading countries in the use of BIM-technologies, authorized the use of BIM-models for all public construction projects, starting in 2016, including digital data transmission required for the building operational phase. The latest BIM review, presented at NBS National BIM report [15], provides research results, mainly aimed at finding solutions to various aspects related to BIM implementation in planning, design and construction processes. BIM for FM is a newly emerged field of activity, thus the existing knowledge on the essence of this subject is still limited. Moreover, the efforts to study information modeling in FM were mainly focused on newly built objects, despite the fact that new constructions make usually the smallest percentage of the total building stock [16]. The actual global experience of BIM application in FM is also insufficient.

3. Results and Discussion
One of the main problems in the field of BIM based management, in our opinion, is the absence of practical processes for model improvement, taking into account as-built documentation. It is still unclear what is most appropriate for data downloading into the model and its further maintenance.

Traditionally, real estate managers are slightly involved into building life cycle processes that is only into later stages of facility transfer to customers [17]. Moreover, project designs are generally not
checked in the context of their impact on life-cycle costs or maintenance. As a result of such
omissions, operational data is either insufficient or inadequate.

Often such necessary data is actually missing or inaccurate, because the model has not been
modified on the basis of design changes made after the completion of the design phase, and thus being
an improper model that would have to correspond to what was built.

The field of facility management is rather inflexible in its approaches to new technologies. The lack
of information models in the FM-industry, as well as the lack of system understanding delay BIM
adoption. This is true important, since the BIM-model in FM is considered a separate building
resource that requires constant maintenance so that it remains valuable for the building itself and its
owners [18].

Besides, the interoperability of BIM- and FM-technologies continues to be a problem point, which
is about to transfer the information and data to those who work at the operational stage. And in fact,
for example, an inherited documentation in existing buildings can be used for the next decade or even
two [19].

The lack of contractual and legal frameworks for the practical BIM application in relation to FM is
another problem area its specific difficulties. Today, most contracts require the transfer of paper
documents containing equipment lists, product data sheets, warranties, spare parts lists, maintenance
schedules and etc. This information is essential to maintain real estate management. Currently existing
process of information transfer to the FM stage is usually carried out manually. Finally, the
transmitted information is incomplete and inaccurate.

Improving data transfer processes is one of the main driving factors for using BIM in FM. Despite
currently existing interoperability problems, the BIM data and information collected during the
building life cycle reduces the cost and time required to collect and build FM-systems. Thus, for
example, data relating to facilities, systems, finishes can be obtained in the form of BIM-models
prepared in a digital format, and at the same time they do not require re-entry into following FM-
systems [20, 21]. Moreover, it is important to improve data quality and reliability, leading to an
increase in the efficiency of FM-organizations.

Analyzing the difficulties associated with the transition from existing FM- to BIM-based processes,
it is important to identify several key problems associated with the practical implementation of this
technology. Thus, it is necessary to develop a brief and clear BIM specification for FM in order to
determine the information necessary to meet specific requirements of this business area and FM-
functions.

Another problem is the limited compatibility between BIM- and FM-technologies, which is
complicated by a huge difference between the life cycles of BIM-, FM-technologies and the full life of
buildings. This means that data standards and interoperability will remain a critical factor for BIM
application in FM-technologies.

The analysis of BIM applicability in FM showed that its value and potential in terms of object
management is mainly as follows:

- improvement of currently existing manual processes of information transfer; increase the
  accuracy of FM-data;
- increase an efficiency of orders execution, in terms of execution and access rate and
  localization of performed interventions. Such value is generated from BIM's ability to provide
  an extensive visual environment and an environment represented by integrated data.

However, there are some difficulties limiting the use of BIM in FM. They include: unclear
definition of roles, responsibilities, and contractual and liability frameworks; difficulties in
interoperability between BIM and FM technologies; lack of clarified requirements for BIM practical
application in FM.

In addition to these difficulties, todays BIM based management has revealed one more problem,
which is associated with a significant difference in the duration of life cycles of BIM, FM-
technologies and the full life of buildings [22,23]. This means that in the medium and long term
perspective, FM-organizations should be ready to work with various information and data standards,
instead of adapting their business processes to specific technologies. Thus, the developments of BIM-
specification for FM, meeting the needs of FM-processes conducted by an organization, should now
become the key to enjoy BIM-based FM advantages and create an opportunity for its organization and
use.

4. Conclusions
An active introduction of information modeling technology into the life cycle of a capital construction
object poses a natural question about the prospects of using this format at the longest stage of
building’s existence, that is management. The solution, which contains a combination of BIM-
technology and FM-processes, integrated with management tasks, allows creating an integrated
informational space, as well as to preserve and possibly increase the benefits of BIM after the
completion of construction processes [24].

Any time soon, perhaps ten years later, a radical adjustment of this information will be required,
taking into account the vast array of city data (public infrastructure, facilities, etc.), allowing to create
truly “smart cities” against the background of the dominant economic digitalization.

The instruction of the President of the Russian Federation on the transition of the national
construction industry to information modeling, published in the end of July 2018, confirms that the
topic of construction digitalization does not leave the agenda and has specific ways of development:

- creating libraries of standard project documentation for information modeling;
- training specialists, providing domestic software development and application;
- adoption of information modeling standards;
- transition to the life cycle management system for capital construction objects through the
  introduction of information modeling technologies, etc.

In this regard, the authors see the future research directions in the analysis of the system and the
rules for the formation of individual BIM-scenarios within an investment and construction project into
a common scenario reflecting the interconnection of BIM technology application processes.

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