Information model of the building and its application in selected phases of the life cycle

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Abstract. Despite various aspects, be it social or economic, construction is considered one of the decisive industries in many countries. In this industry, it is not possible to automate and streamline processes like for example in the automotive industry, as each construction work is unique every time. However, by implementing modern technologies of the 21st century, it is possible to streamline the processes in the pre-investment, investment and especially in the phase of using the construction work. Since the construction work is supposed to be used and functional for several decades. A suitable tool is the use of the building information model in short - "BIM". This issue has been moving and progressing significantly in recent years. By implementing these digital technologies in construction projects, it is possible to significantly speed up the course of construction, avoid collision situations, save financial resources, and last but not least, when creating a high-quality model, it is possible to create a digital twin of a given construction work, which can significantly optimize and streamline processes right in the use phase. It is in this phase of the life cycle that there is the greatest scope for using the completed building model, which of course must be revised during the first two phases to make it as accurate as possible and usable for management and maintenance. During this phase, it is also appropriate to implement software tools such as Computer Aided Facility Management (CAFM).

1 Introduction

During their life cycle, buildings consume a considerable amount of energy and resources. This fact has a significant impact on the environment and also a considerable economic impact [1]. The world is currently facing climate impacts such as global warming and many studies indicate that the climate is changing rapidly and this fact will continue as the years pass [2]. The European Union is committed to reducing greenhouse gas emissions by 50% by 2050 compared to 1990. Peacock buildings play a high role in energy consumption [3]. In particular, older buildings consume the most energy and also produce the most greenhouse gases. Massive construction is taking place all over the world, which is associated with the migration of the population to urban areas. It is assumed that by 2030 this share will reach almost 60% [4]. Therefore, at present, great emphasis is placed on energy saving in buildings

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and the independence of these buildings. This efficiency can also be achieved using modern tools such as the building information model. Subsequently, the information model of the building created in this way can be used in the administration and maintenance of the given building, for example with the connection of CAFM (Computer Aided Facility Management) software. Facility management itself is not a very widespread topic in Eastern Europe. It is precisely in the phase of use of the construction work that the greatest costs arise, as the construction work is often used for longer than 50 years. The construction life cycle can be divided into 4 phases, which are: pre-investment phase, investment phase, use phase and liquidation phase. These phases are shown schematically in Figure 1 below.

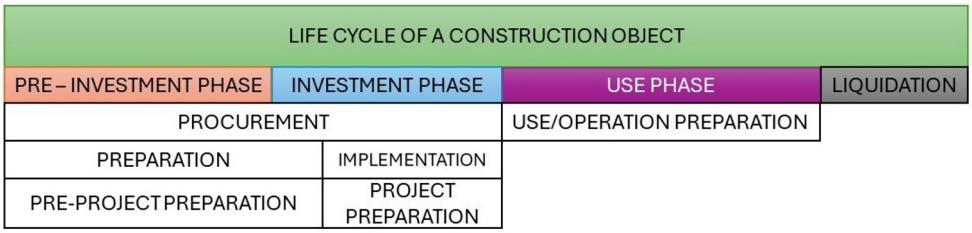

Fig. 1. Life cycle of the building (source: the author).

2 BIM – building information model in the use phase

The building information model in short, i.e. BIM, is a relatively new issue that has been moving and progressing more and more significantly in recent years. By using BIM, it is possible to use technologies and systems that are based on data analysis more effectively and, last but not least, it is possible to reduce the financial resources for the entire construction work. The concept of information modeling has been known since 1974, but the name BIM - Building Information Modeling has been used since of 2002. Abbreviation "B" - Building primarily does not refer only to the buildings themselves, but includes the entire construction and also the construction process. The abbreviation "I" - Information is therefore information about the construction and the abbreviation "M" - Modeling can also be defined as management, which better describes the whole essence of BIM and thus enables obtaining information about the construction and subsequently about its management [5]. The information contained in the building information model is shown in Figure 2. The presented article deals with BIM in the building use phase.

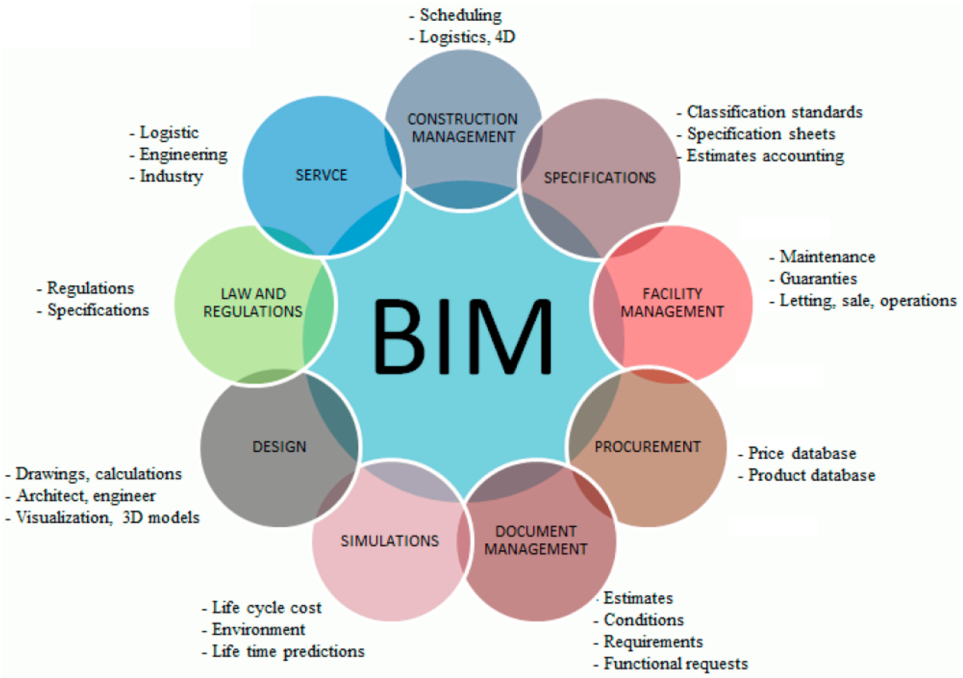

Fig. 2. Information model of the building (BIM) and elements in the life cycle [6].

The BIM model can be used not only in structural engineering, but in the entire engineering construction. This model can be imagined as a database of information, which represents complex data from the design of the construction object to its actual removal. All participants in the construction process contribute to the information database. In order to achieve the maximum use of BIM, it is necessary that none of the participants refuse to use the model and that they constantly contribute their data, otherwise the efficiency of using the information model is significantly reduced. Thanks to this technology, the construction industry acquires a completely new dimension in the planning, implementation and use of the construction work. The entire model is thus stored on a digital storage, where every construction participant can update information about the construction object. Thus, the 3D model lives with the object and thus provides data and analysis during the construction and use of the construction work. The introduction of information modeling of constructions represents the digitization of the construction sector, it is necessary that more and more participants start dealing with this digitization, since the use of digital processes, automation and qualification of workers significantly contributes to the future, whether from economic or social development [7].

2.1 Use of the information model of the building in the use phase

The information model of the building, which is prepared for the given construction work, represents a set of complete data about the building, which can be used in the management and maintenance of buildings. Currently, the handover of the building is taking place by handing over the documentation of the actual state of the building, where all changes and modifications compared to the original project documentation are recorded, it can also be done after the implementation focus of the building, if of course it is necessary and the external dimensions of the building have changed. Also, when the building is handed over, the necessary protocols, audit reports, tests and many other documents are handed over,

which are necessary for the approval of the building. At the moment when this information is submitted, this data is current and valid, however, with the passage of time, this data may change significantly or even some of the data may be lost. This obstacle should be solved by the BIM model of the building, where building managers will always have an up-to-date model and up-to-date data available. Of course, this model must be constantly worked with and must be constantly updated and supplemented with new data [5]. The BIM model is able to contain information that can reflect the current state. This information can be, for example, information about suppliers, warranty periods or even technical reports of individual devices or elements. This information is beneficial for the building administrator, who can respond in a timely manner to the maintenance or revision of the given technological devices or elements located in the building. If the given construction work is made using the BIM model, it is possible to save 3-5% of maintenance, management and energy costs, which can be a significant financial saving during the life cycle in the use phase [8]. In information modeling of buildings, it is also important to what level of detail the given construction work is modeled. The level of detail can also be made to the level shown in Figure 3 below.

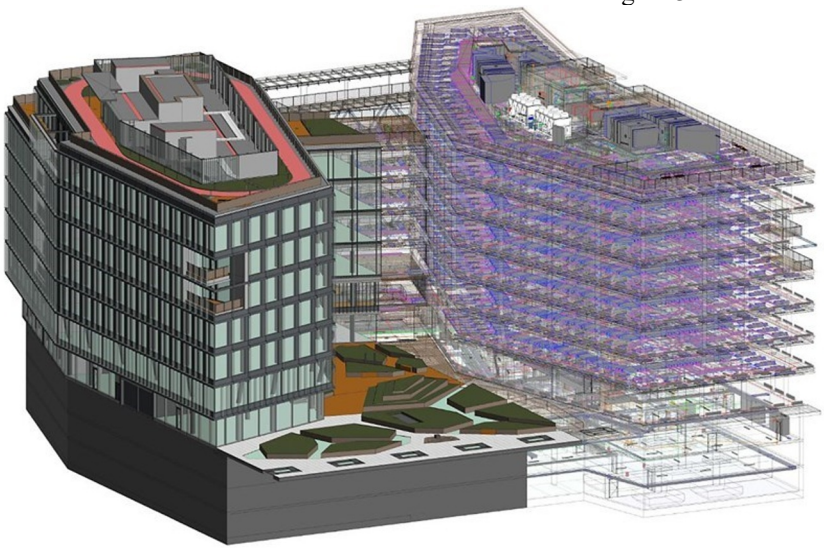

Fig. 3. Information model of the Visionary building [9].

2.2 CAFM systems

The CAFM system is primarily intended for top management, which creates strategic plans with the aim of cost optimization. This top management tries to reduce the costs of operating the building and increase the quality of the services provided [10]. Nowadays, almost every large company has the majority of data in electronic form. Qualitative parameters of software solutions in the field of CAFM can be expressed by how the software is ready to process the given data, open it and then transform it and send it to interested participants. These software solutions usually contain the following data [11]:

- passporting of property, which contains a graphic representation of data
- management and maintenance of property or buildings
- property inventory
- real estate and property records
- management of rental relations and warehouse management
- property records from an accounting and tax point of view

- documentation and contracts with lessors, suppliers
- records of fire protection, trainings
- records of revisions, ongoing checks and service inspections
- overview of cost items for energy, cleaning, water consumption

It is necessary to add that, in addition to the parameters considered above, it is necessary to monitor whether the software is transparent, clear and whether its control is not too complicated. An important factor in choosing suitable software for the organization is also the purchase price of the entire software, whether the license is unlimited or the entry price is paid monthly, quarterly or annually. Also, whether the purchase of the given software is connected to the purchase of other hardware items, such as the purchase of a new computer or tablet. Because of these aspects, it is necessary to pay sufficient attention when choosing a given software solution. Therefore, it is advisable to monitor what software is available on the market, what are their price parameters, what items the software offers, how many participants the software is available to, and last but not least, how it is possible to communicate within the software or how communication with other software takes place. If the choice of software is underestimated, this aspect can lead to ineffective management and costs can increase many times. Facility management is also constantly evolving, and software solutions are also evolving along with it. New software is coming to the market or software solutions already in use are being optimized and developed. Therefore, it is necessary that every participant who is involved, either in the software or outside it, contributes and evaluates the overall operation of the organization or building [12].

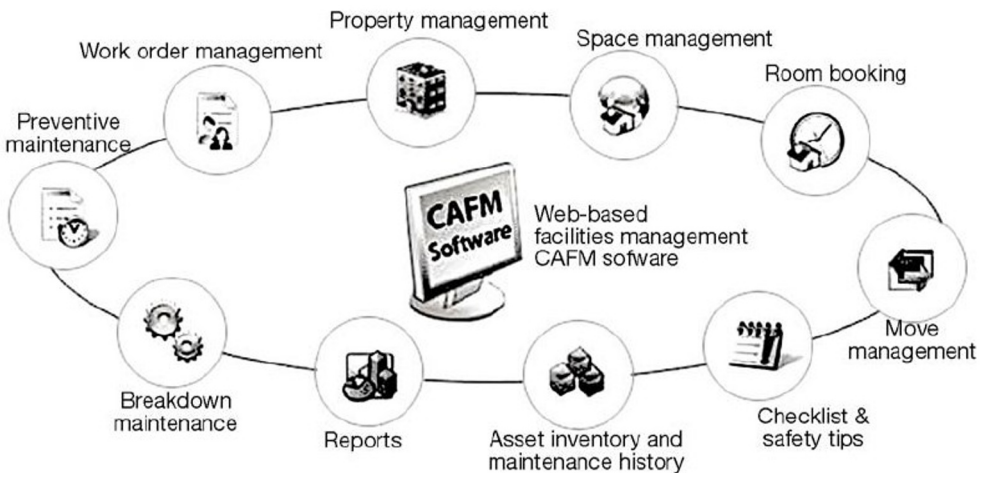

Fig. 4. Software CAFM [13].

3 Conclusion

The BIM technology itself can be used not only in the design, construction, but also in the management and maintenance of a specific construction work. When implementing BIM technology, it is possible to upload the completed model of the construction work to the CAFM software environment and connect these software solutions to each other. The issue of Facility management includes a wide range of options, thanks to which it is possible to more efficiently set up the management and maintenance of the given construction work. The processes themselves in the management and maintenance of the construction work should be optimally set to guarantee the operability of the construction work. During operation, the

parameters of use and the purpose of the building may change. Since the phase of use is the longest stage in the phase of the life cycle of the construction, it is necessary to subject the construction to inspection and, if necessary, to remove all deficiencies or errors in a timely manner. Since the buildings contain construction elements that are categorized as short-lived elements, these elements must be modernized or completely replaced. This overview post should serve as a way to implement the software solutions in question and thus facilitate the work of building managers and, last but not least, maintain intervals in the management and maintenance of individual elements and devices located in the building.

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