Smart Building in Relation to Facility Management, Overcoming Barriers to Digitalization

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Abstract

The development of digital technologies can significantly contribute to improving building management and maintenance processes, bringing revolutionary changes in the field of facility management. The digitization of recorded data allows for more efficient management of operational and maintenance processes throughout the entire life cycle of a building, which leads to cost reduction, optimization of workflows and extension of the service life of technical equipment. A key tool in this transformation is the concept of a digital twin, which allows the creation of accurate virtual models of buildings not only for new projects, but also for existing buildings. These digital models provide comprehensive information about building elements, technical equipment and operational parameters, which supports more effective decision-making in the field of management and maintenance. However, with the development of digitalization, there is also a need to identify and address potential risks associated with the implementation of these technologies. The main challenges include cybersecurity, personal data protection, system interoperability and the need to standardize digital solutions. For the successful implementation of a digital twin, not only technological security is essential, but also legislative and organizational readiness of entities managing buildings. Digitalization in building management and maintenance thus represents a significant step towards smarter, more efficient and more sustainable real estate management, while its full potential can be utilized through properly designed strategies and technological solutions.

Keywords: *Buildings; Digitalization; Smart Building; Facility Management*

1. Introduction

Building management dates back to the time when the first buildings were built. Every building requires constant maintenance and management, which is provided by a certain type of manager. Traditionally, these are basic maintenance and cleaning services that can be handled by a single worker. Without regular maintenance, buildings would gradually deteriorate, significantly reducing their lifespan. However, over time, building management services have been constantly improved and expanded. Building maintenance is often associated with the effective management of physical and technical resources that are needed to ensure the functionality and safety of buildings [1]. This process includes planning, organizing, leading and controlling all activities related to building management, with an emphasis on preventing and solving problems that may affect their operation. The correct selection of building materials, appropriate design solutions and optimization of these factors can significantly affect the costs of management and maintenance, as well as extend the life cycle of a building [2].

The modern approach to building management and maintenance is currently increasingly focused on the integration of advanced tools such as Building Information Modeling (BIM), Facility Management (FM), Computer-Aided Facility Management (CAFM) and also the relatively new blockchain technology. These tools enable more efficient building management, cost reduction and improvement of service quality. BIM is proving to be a revolutionary tool in the field of building management, as it allows the creation and management of digital models of buildings that contain all relevant information about their physical and functional characteristics [3]. According to the Gerrish study [4], BIM is used to visualize and manage the energy performance of buildings, which contributes to the optimization of operating costs and improved sustainability. BIM also supports collaboration between different project participants, which is key to effective building management and maintenance [5]. Facility Management is a multidisciplinary approach that focuses on optimizing the operation and maintenance of buildings. Currently, FM is increasingly integrated with technologies such as CAFM systems that enable the automation and streamlining of building management processes. These systems provide tools for maintenance planning, facility management and cost tracking, leading to improved efficiency and reduced operating costs [6]. As Okoro's study [3] states, facility managers play a key role in securing the value and efficiency of an organization, and their roles are constantly evolving in line with modern trends. Blockchain technologies are also starting to emerge in the field of building management, offering new opportunities for ensuring transparency and trust in management and maintenance processes. The use of blockchain can improve asset traceability and management, which is particularly important in the context of managing complex buildings and infrastructures [7]. These technologies enable decentralized data storage and simplify processes such as contract and transaction management, thereby contributing to more efficient building management. Case studies show that integrating these modern technologies into building management can lead to significant improvements in efficiency and sustainability. For example, the implementation of BIM and CAFM in building management allows for better planning and prediction of maintenance costs, which contributes to long-term sustainability and reducing the environmental impact of buildings [8]. Similarly, the use of blockchain technologies can improve management processes and ensure transparency in transactions, which is key to the

effective management of complex buildings [9]. A modern approach to building management and maintenance through technologies such as BIM, FM, CAFM and blockchain represents a significant step forward in optimizing operations and improving the quality of services. These technologies not only increase efficiency and reduce costs, but also contribute to sustainability and transparency in building management. Building management and maintenance processes can be digitized to a large extent. The individual process steps are discussed in the following figure (Fig. 1).

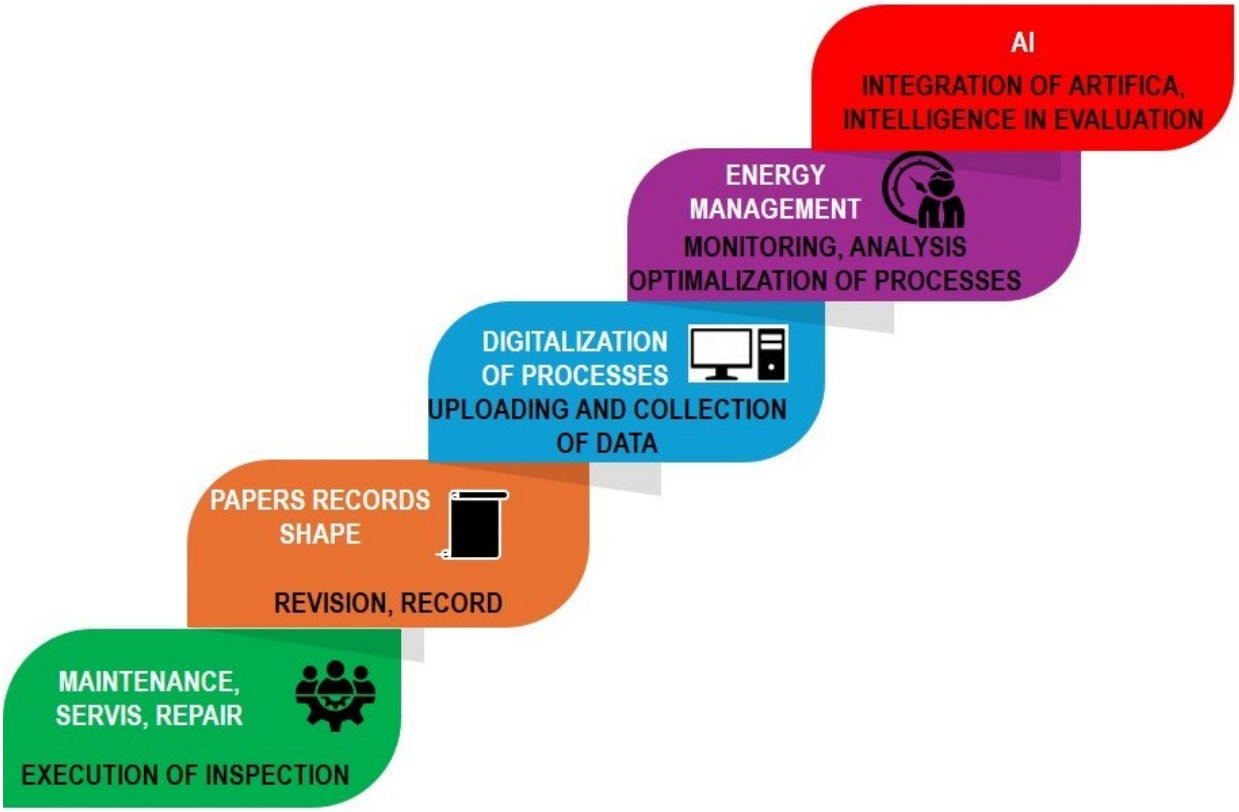


Fig. 1 Digitalization of management and maintenance processes (source: author)

2. Using BIM in Building Management and Maintenance

Building Information Modeling (BIM) is emerging as a revolutionary tool in building management and maintenance, with its application extending to various aspects of the building life cycle. BIM provides a comprehensive and dynamic approach to building management that includes not only visualization but also data integration and analysis, leading to more efficient operation and maintenance management [10]. One of the main benefits of BIM in building management is its ability to store and make available a vast amount of information about the building. This information can include technical specifications, maintenance schedules, and repair history, allowing the building manager to respond quickly and effectively to maintenance needs [11]. BIM also supports predictive maintenance, which means that building managers can predict when maintenance or repair will be required based on the analysis of historical data and current conditions. In this way, maintenance costs are reduced and the lifespan of buildings is increased [12];[13]. For example, Lin et al. presented a system based on BIM and mobile technologies that supports maintenance management and allows access to up-to-date building information in real time [11]. In the field of building management, BIM is proving to be an effective tool for improving collaboration between different professionals. Thanks to the ability to share and make information available in real time, architects, engineers and building managers can collaborate to optimize maintenance processes and reduce costs [14]. Despite the many advantages that BIM offers, there are also challenges associated with its implementation in the field of building management and maintenance. The most common obstacles include a lack of expertise and technology, as well as the need for a change in culture in organizations [15].

Building information modeling represents a significant advance in the field of building management and maintenance, with its ability to integrate and analyze data leading to more efficient operation management and cost reduction. However, to achieve the full potential of BIM, it is necessary to overcome existing barriers and ensure adequate training and support for all participants in the process. The figure (Fig. 2) describes how it is possible to create a complex data model necessary for management and maintenance purposes using graphical and non-graphical information.

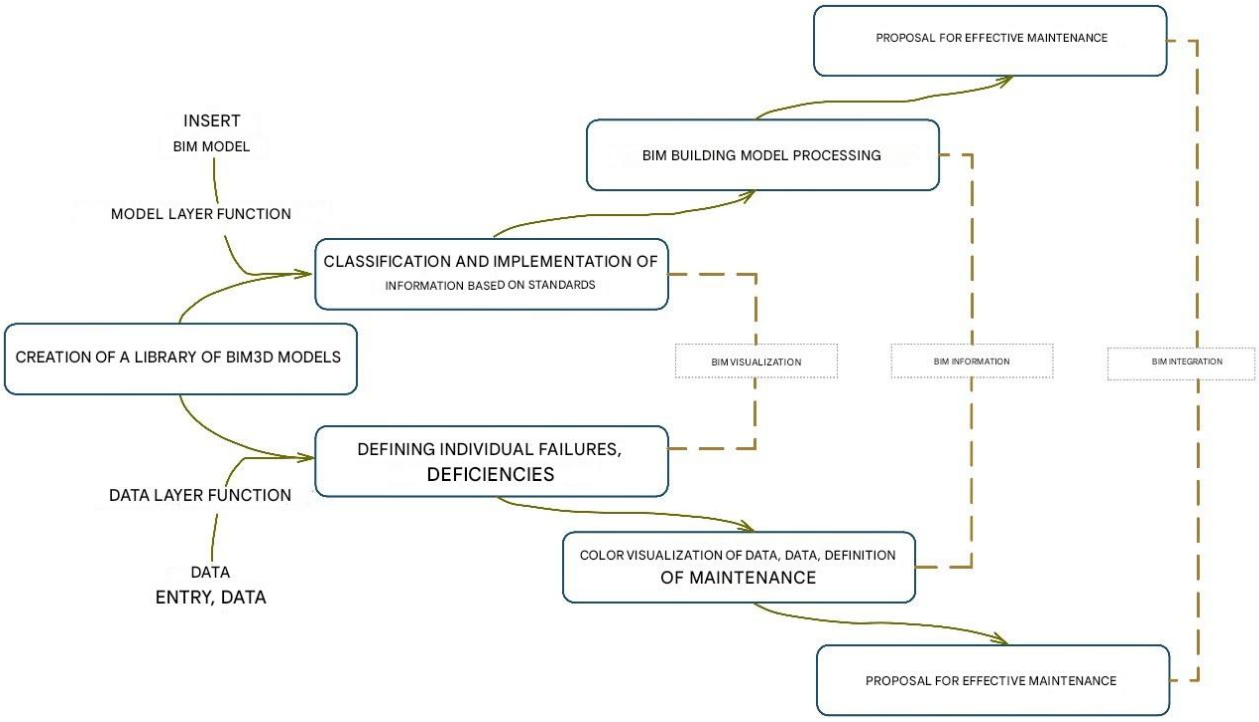
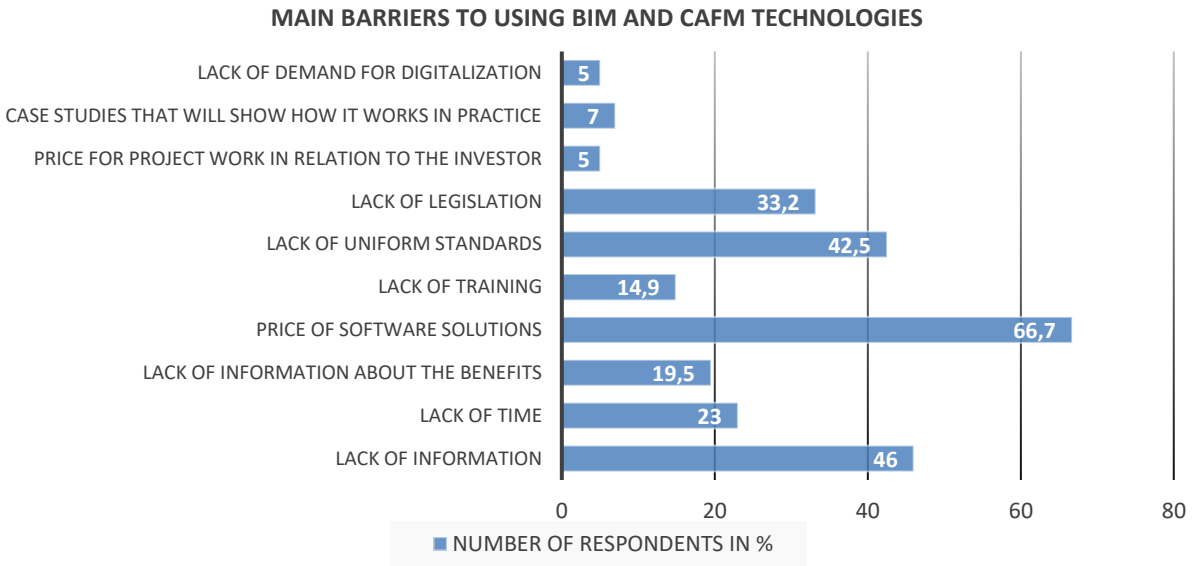


Fig. 2 Flowchart of using a BIM-based maintenance system [12]; own finishing.

3. Definition of the Main Barriers to the use of Digital Technologies

Building management and maintenance is carried out in various ways today, with digital technologies such as BIM and CAFM offering opportunities for their optimization, automation and more efficient management. Despite their advantages, there are obstacles that prevent their wider application in practice. To identify these barriers, a questionnaire survey was conducted, which focused on the level of awareness and use of digital tools in the field of Facility Management. Over 1,200 experts from various sectors were interviewed, including designers, construction contractors, education employees, public administration and property managers. More than 7% of those interviewed provided answers, with respondents working in the field of property management and maintenance selected for the purposes of the analysis. Out of 87 relevant responses, 58 respondents are actively involved in building management. One of the questions in the survey focused on identifying the main obstacles to the implementation of BIM and CAFM technologies in building management and maintenance.



The above graph, which shows the main barriers to the use of BIM and CAFM technologies, shows that:

- the most significant obstacle is the price of software solutions, where this fact was mentioned by up to 66.7% of respondents,
- the lack of information is another significant barrier, with 46% agreeing on this factor,
- the third factor and no less important according to respondents is the lack of uniform standards 42.5%, which indicates the need for better information and standardization in the field of digitalization in building management and maintenance

- the lack of legislation is also an important factor according to respondents, which was mentioned by over 33% of respondents.

4. Conclusion

The digitalization of building management and maintenance represents a fundamental step towards more efficient and sustainable management and performance of management and maintenance. The implementation of modern technologies, such as BIM, CAFM and digital twins, allows for the optimization of operational processes, reduction of costs and extension of the service life of technical equipment. Despite the fact that these tools bring many advantages, their widespread application in practice encounters several barriers, in particular the high costs of software solutions, lack of information, absence of uniform standards and legislative ambiguities.

The results of the survey show that the key factor for the successful implementation of digital technologies in the field of Facility Management is not only technological readiness, but also systematic support from the state, the creation of a legislative framework and the education of experts. Future developments in this area will depend on cooperation between technology companies, building managers and regulatory authorities, while awareness-raising activities and the dissemination of information about the benefits of digitalization will also play an important role.

Overcoming existing barriers and effectively using digital technologies in building management can lead to significant improvements in service quality, transparency and process efficiency. Digitalization can thus significantly contribute to the sustainability and long-term cost-effectiveness of property management and maintenance.

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