Barriers for Efficient Facility Management: Perspectives of BIM-users and non-BIM-users

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Abstract

After replacing the conventional design and construction practices of the architecture, engineering and construction (AEC) industry, building information modelling (BIM) is now influencing the way facility managers operate buildings. Although the use of BIM in FM has been disseminating across the globe, the industry is still in need of explicit evidence of its practical implications and potentials for efficient and effective FM practices. The present study amplifies the previous findings on the current BIM awareness and utilization within the FM industry in Turkey. This study analyses the problem areas of the FM profession from the perspectives of BIM-user and non-BIM-user facility managers and identifies the usage areas of BIM in FM. The results indicate that BIM has great help for visualizing the exact locations of building components, creating and updating digital assets, accessing the real-time facility data, tracking maintenance and repair works and monitoring energy consumption, specifically for large projects. Even though BIM enables the involvement of FM teams for introducing operational requirements in the early phases, the absence of up-to-date facility information seems to be the major problem area for BIM-enabled FM practices.

Keywords: Facility management (FM), Building information modelling (BIM), Barriers, Usage areas

1. Introduction

The initial scope of facility management (FM) practice was cleaning the buildings and maintaining the building equipment (Atkin and Brooks 2021, FMA 2012). In the late 1980s, FM has been accepted as a profession (Nor et al. 2014) that embraces multiple disciplines to ensure the functionality, comfort, safety and efficiency of the built environment by integrating people, place, process and technology (IFMA n.d.). Today, FM encompasses various activities such as maintenance operations and repair works, workspace management, energy planning and management, renovation, refurbishment and retrofitting, administrative and office services, emergency planning and management, financial management and FM personnel training for the efficient and effective operations of physical assets (Atkin and Brooks 2021, Chotipanich 2004, Springer 2001). To smoothly operate all those diverse disciplines and complex processes, the FM industry needs to embrace digitalisation and benefit from different information and communication technologies (Bröchner et al. 2019, Redlein and Grasl 2018).

FM professionals have been using numerous computer integrated FM environments, namely building automation systems (BAS), computerized maintenance system (CMMS), computer-aided facility management (CAFM), and integrated workplace management systems (IWMS). Although the conventional building handover process has evolved from paper-based drawings and documents to digital copies, FM teams need to transfer an excessive amount of data into their systems (Patacas et al. 2015). This transfer process is one of the major problem areas of FM because it takes a significant amount of time of the FM staff and is open to errors and data losses (Kasprak and Dubler 2012, Patacas et al. 2015). As a solution, the last decade has introduced the building information modelling (BIM) to the FM practice. BIM is an IT-enabled approach that involves applying and maintaining the integral digital representation of all building information for different phases of the project life cycle in the form of a data repository (Gu and London 2010). In the early phases of the building life cycle, BIM enables enhanced communication and coordination between project stakeholders, reduced errors and omissions, decreased project cost and project duration for architecture, engineering and construction (AEC) professionals (Azhar 2011, Bryde et al. 2013, Ghaffarianhoseini et al. 2017, Love et al. 2012, Suermann and Issa 2009). In the operational phase, BIM can help facility managers to create digital assets, visualize the exact locations of all kinds of building elements in a 3D environment, plan and track maintenance tasks, manage workspace, monitor the indoor environmental conditions and building performance, and train FM personnel for emergency situations (Becerik-Gerber et al. 2012, Pärn et al. 2017).

As a natural result of its benefits, the AEC firms are gradually adopting BIM into their practices. However, its implementation within the FM industry is remarkably low. Lack of owner demand, economical concerns, fragmented FM data, data exchange standards and interoperability issues, incomplete BIM models, model maintenance ambiguities, and lack of BIM experienced FM personnel are the major reasons for limited BIM implementation within the industry (Becerik-Gerber et al. 2012, Korpela et al. 2015, Pärn et al. 2017, Patacas et al. 2015). Besides, a recent study uncovers the short-term FM contracts as another hindrance for low use of BIM (Tezel et al. 2021). On the other hand, both researchers and practitioners are intensely focusing on the ways to implement BIM into FM since 2015 (Wong et al. 2015). Current FM practices are not fully benefiting from BIM but the professionals are expecting BIM to play an important role in the industry's near future. To carry out a smooth implementation process, facility managers first need to know with which purposes FM experts can use BIM and which barriers can BIM overcome to achieve an efficient and effective FM service. Therefore, the objectives of this study include understanding the BIM's contributions to the on-going problems of FM practices and identifying the BIM applications areas in FM.

2. Research Method

2.1. Background and research questions

Previous research by Tezel et al. (2021) demonstrates that FM professionals in Turkey have high BIM awareness but low BIM utilization. Although lack of owner demand, short-term contracts, limited budget, old building stock and incompetent FM workforce constitute the underlying reasons for the low BIM utilization, BIM is expected to be a trending phenomenon within the upcoming five years. The current study expands on previous findings by analysing existing barriers to efficient and effective FM practices and identifying BIM application areas in FM. The self-administrated questionnaire aims to find answers to the following questions:

RQ 1: Do the barriers to efficient and effective FM practices differ in conventional and BIM-based methods?
RQ 2: For which operational functions do the FM personnel utilize BIM?

2.2. Sampling method and sample characteristics

This study targets professionals from the three largest FM associations, namely, Turkish Facility Management Association (TRFMA), Professional Facility Managers Association (PTYD), and Urban Facility Management Association (TRKTYD), and a couple of well-known

international FM companies in Turkey. There are more than ninety FM companies constituting these three associations, -among them are six international and two state-owned firms-, providing various hard and soft FM services. The online survey link has been shared with these organizations via email and responses were collected between February and March 2021. Overall, thirty-eight experts have responded to the survey. However, one response is excluded during the data screening process because the missing information related to the respondent's professional background prevents the credibility of the answers. In the end, the study population consists of thirty-seven experts.

Tab. 1: respondent characteristics

	Experience in years (b)						**BIM user (c)**		
Position (a)	**<5**	**6-10**	**11-15**	**16-20**	**21-25**	**26+**	**Yes**	**No**	**Total**
General Manager	1	6	3	4	1	1	2	14	16
Vice GM	-	1	2	-	2	1	-	6	6
Director	-	3	5	-	1	-	3	6	9
Consultant	1	-	-	-	-	1	1	1	2
Specialist	1	1	-	-	-	-	2	-	2
Other	1	-	-	1	-	-	-	2	2
Total	**4**	**11**	**10**	**5**	**4**	**3**	**8**	**29**	**37**

Table 1 represents the current positions of the respondents (column a), their years of experience in the FM profession (column b), and whether they have BIM experience or not (column c). Overall, the largest portion of the respondents (16 out of 37) are general managers of FM companies, followed by directors (9 out of 37), and vice general managers (6 out of 37). Also, the majority of the respondents (22 out of 37) have more than 10 years of experience in the FM industry, which indicates a highly representative and experienced study population. The survey includes the question of "have you ever worked with BIM" to determine BIM experiences of the respondents. Around twenty per cent of the respondents (8 out of 37) have used or are still using BIM in one or more of their projects. The latest research of BIMgenius (2020) also reports the use of BIM for FM purposes in Turkey as ten per cent. Both results refer to shifting interest of FM professionals to the BIM subject.

3. Different Perspectives Towards the FM Barriers

A detailed review of both scientific literature and industry reports reveals a number of hindering factors for FM. Although most of these barriers have generic characteristics, they have different impacts on FM operations depending on the facility type and size, required services, applied technologies, and so on. Given the emerging BIM implementation within the FM industry, it is important to distinguish the problem areas for conventional and BIM-based approaches. Respondents were asked to indicate their agreement or disagreement with the given barriers in order to identify the main issues influencing the efficient and effective operations of FM teams. The responses are divided into categories based on the respondents' BIM experiences, as shown in Figure 1.

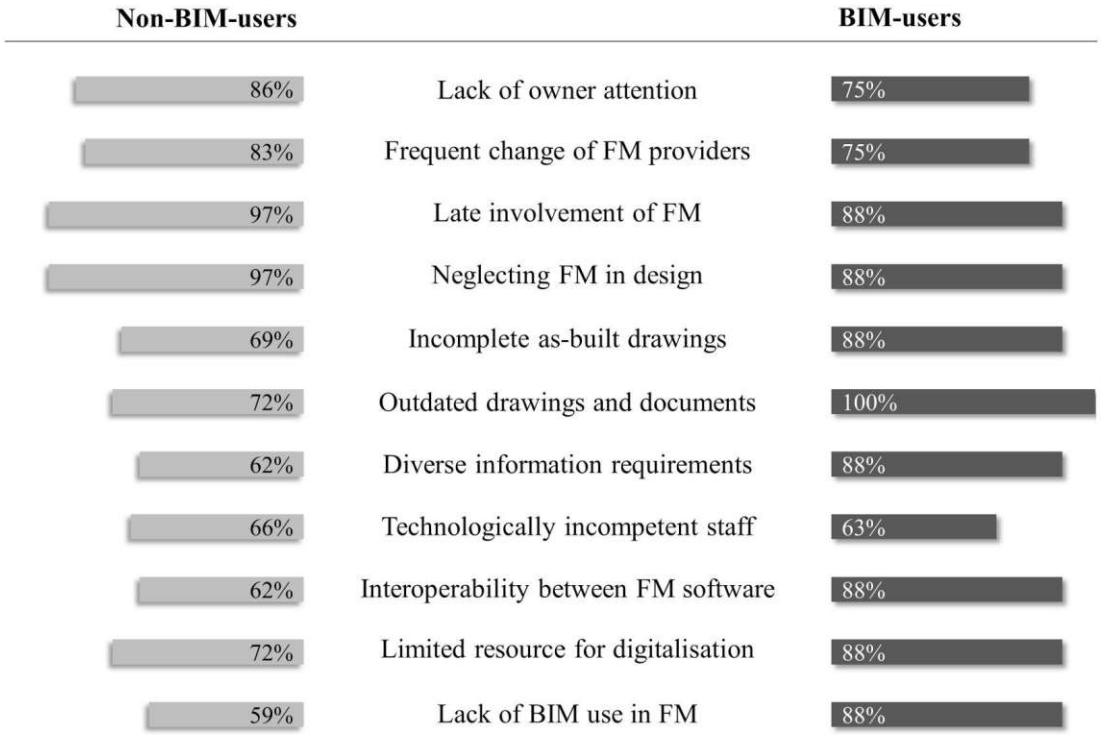

Fig. 1: barriers for efficient FM practices

Figure 1 reveals that all the listed barriers are influencing FM operations to some extent regardless of the use of BIM. In other words, neither conventional nor BIM-based methods are a solution to the given problem areas. However, the most and the least frequent problems of both approaches are different. Among the non-BIM-users, late involvement of FM professionals in the projects and neglecting the FM requirements in the design phase are the most frequent problems with the highest rate of 97%. On the other hand, BIM-users fully agree

on the outdated drawings and documents of facilities as their most frequent problem. The most frequent problems of non-BIM-users settle among the second most frequent problems of BIM-users (88%) together with the delivery of incomplete as-built drawings, diverse information requirements of operational tasks, interoperability between FM software, allocating limited resources for digitalisation and insufficient use of BIM in FM.

The two groups also differ in terms of the least frequent problems as well. To the non-BIM-users, lack of BIM use in FM is the least frequent problem (59%) whereas to the BIM-users it is the technologically incompetent FM workforce (63%). Even though the scores seem close, the tiny difference between the two items embodies certain insights for FM professionals. First of all, although it is the least frequent problem for the BIM-users, technology-related incompatibilities of FM staff are still an important problem with the 63% frequency. To fully benefit from BIM and other related technologies, it is important for FM personnel to use them actively and properly. On the other hand, increasing use of machines and robots cause some people the fear of losing their job. At this point, managers need to remind the importance of the personnel for building operations, emphasize the vitality of technology for fast and accurate decisions, and provide necessary training and support for the staff. Another point is the thoughts of the non-BIM-users towards the current usage of BIM in FM. A non-negligible amount of them (59%) think that the lack of BIM use causes inefficiencies in operational tasks. Hence, the firms using BIM in FM are going to be the competitively advantageous ones.

4. Usage Areas of BIM in FM

The preceding analysis clearly demonstrates that BIM is not the ideal solution to the existing efficiency issues in FM practices. Nonetheless, the industry is recognizing and implementing BIM with increasing enthusiasm due to its promising potential. Becerik-Gerber et al. (2012), Sabol (2013), Matarneh et al. (2019), and Gao and Pishdad-Bozorgi (2019) identify and explain the application areas of BIM in FM. However, because each facility has its own needs and requirements, there is no one-size-fits-all solution in the operational. Respondents were asked to specify their reasons for employing BIM in facility operations, and the results are shown in Figure 2.

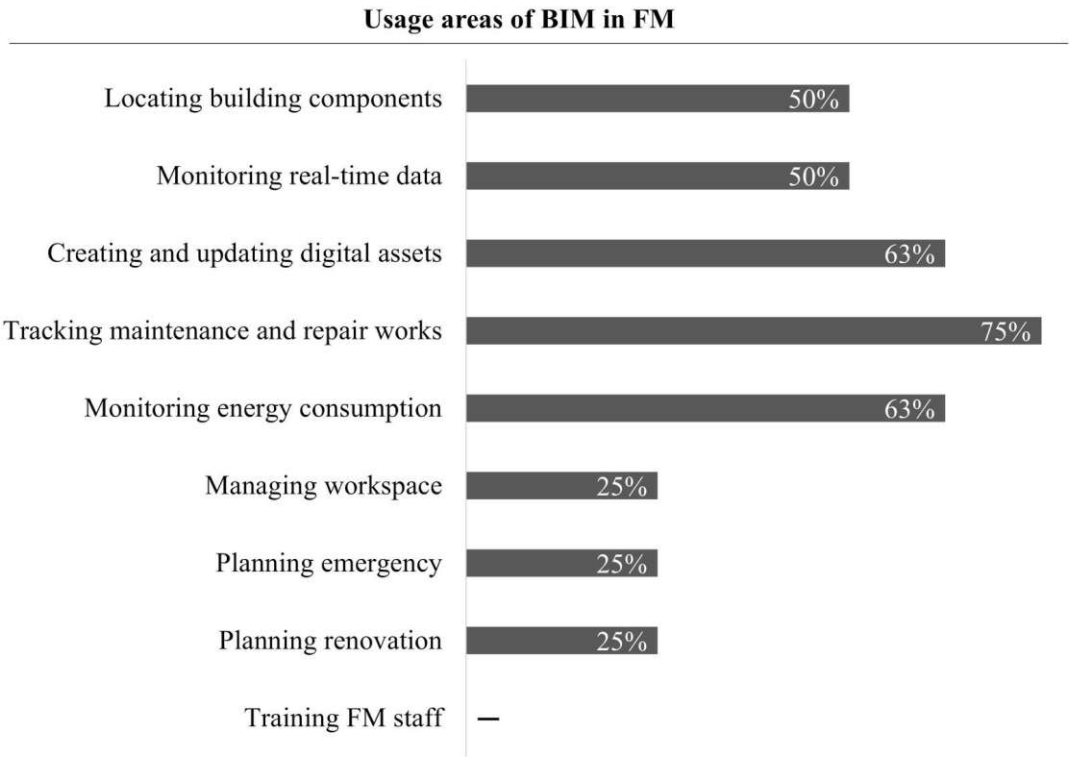

Fig. 2: usage areas of BIM in FM

As seen in Figure 2, the most frequent BIM application area in FM is tracking maintenance and repair works. 75% of the BIM-users issue maintenance and repair work orders of equipment or building components and track their progress using BIM. In connection with this, creating and updating digital assets and monitoring energy consumption are the second most frequent application areas of BIM in FM. In the conventional handover process, it is highly probable to observe discrepancies between the hard copy documents and the actual building. Moreover, during their life cycle buildings face numerous changes in the furniture, MEP system components, fire and other safety systems, façade elements and so on. Therefore, it is crucial not only to keep the data on an easy access digital platform but also keep them up-to-date (Korpela et al. 2015). At this point BIM emerges as a promising platform because it can capture the data in a 3D environment, perform further analysis and simulations, and enable data transfer between different software systems. Although data updating requires extra time or use of advanced technologies such as point cloud and laser scanning, a single and transferable data source contributes to the decision-making process of facility managers and FM personnel.

FM professionals spend half of their time in building operations tasks including conducting equipment checks and daily rounds, maintaining facility and systems, and conducting facility repair activities (NIBS 2015). To efficiently perform these activities FM personnel need to

detect the exact location of building components and related information as soon and accurately as possible. Although BIM models are able to capture and visualize the necessary data and related documents (i.e., location, manufacturer information, attributes, manuals and warranties, etc.) of each component, only half of the users benefit from BIM for locating building components and monitoring real-time data of facilities. Furthermore, having the aforementioned data and real-time monitoring of the facility are critical to take immediate actions during emergency situations (Becerik-Gerber et al. 2012). However, only 25% of the users are utilizing BIM to manage emergencies, plan renovation and manage workspace. Nevertheless, the most interesting finding of this study relies on the missing use of BIM as a personnel training platform. BIM models are capable of realistically visualizing buildings and other assets so that FM personnel can get familiar with the facility in a virtual environment. Yet, none of the BIM-users benefits from BIM as a training platform. The last-minute involvement of FM teams might be the reason for the limited time for training, however fast personnel adaptation to the facility plays a crucial role especially in emergencies.

5. Conclusions

The population of BIM users in the FM industry is remarkably low compared to the AEC. Yet integration of BIM and FM fields is attracting the world's attention. Increasing number of studies in this field are trying to identify how BIM can improve the FM practices and develop various strategies to its implementation barriers. However, lack of real-life examples in BIM-based FM applications causes building owners to approach it with suspicions. Following the previous study revealing the BIM awareness and use in the Turkish FM market, the present study aimed to analyse the problem areas of the FM practice from two different perspectives and identify the current BIM applications in FM. Results show that both conventional and BIM-based methods struggle with similar problems. However, it seems that BIM handles the two major problems, namely, late FM involvement and neglecting FM requirements in early phases better than conventional methods. This study also reveals that BIM is actively used for tracking the maintenance, creating and updating digital assets and monitoring energy use within the facilities, but it can help the other functions of FM as well.

The small number of survey participants and even fewer BIM-users may have a negative impact on the study's representativeness. However, BIM is still a relatively new topic in FM practice around the world, and not all operational functions are suitable for management with BIM. As a result, this study is expected to provide a broad overview of the ongoing BIM-based FM

practices in Turkey. FM professionals anticipate that BIM will be a trending phenomenon in the FM market in five years from now. Considering this expectation of the industry, more research should be conducted to develop BIM implementation strategies for FM companies to facilitate a smooth transition process.

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