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**CIVIL ENGINEERING & ARCHITECTURE**  
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Volume 2: Architecture

**AHMET CAN ALTUNIŞIK**  
**HASAN BASRİ BAŞAĞA**  
**VOLKAN KAHYA**  
**VEDAT TOĞAN**



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**Editors**

Ahmet Can Altunışık

Hasan Basri Başağa

Volkan Kahya

Vedat Toğan

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## BIM-enabled facilities management: MSGSU bomonti building case

Salih Ofluoglu<sup>1</sup>

<sup>1</sup> Antalya Bilim University, Department of Architecture, Antalya

### Abstract

**Purpose:** Facility management (FM) is a managerial activity that accounts for a significant portion of the building lifecycle costs. Information transfer from the previous design and construction phases is very important for the success of this information-based activity. Building Information Modeling or BIM (Building Information Modeling) approach ensures that building information is transferred correctly to the operation phase in interdisciplinary collaborative works in project production. Building information models also contain spatial and asset information, which is important for facility management. This study proposes a working systematic about how FM should be carried out in a university building through the BIM approach.

**Study design/methodology/approach:** This study relies on the simulation/modeling research method. Mimar Sinan Fine Arts University (MSGSU) Bomonti building was used as a case. During the study, first, Architectural, Structural and MEP models were created that reflect the “As-Built” state of the Bomonti building. Then, this model was transformed into an “As-Maintained” BIM model by revising it and entering useful spatial and asset parameters for FM operations. OmniClass international standard was used as the convention for naming and defining MEP assets. Some model data was associated with external documentation such as the User and Maintenance manuals. Building information model data was transferred to both open-standard and proprietary FM platforms where checklists, maintenance periods and contact persons for assets were added. FM platform enabled to conduct of advanced space and asset inquiries.

**Findings:** This paper presents an example of the management of spaces and assets in a building using a BIM-assisted FM system. It recommends a working methodology that relies on contemporary international standards for inventory creation, data classification and parameter naming that would be useful for future similar projects.

**Originality/value:** The BIM-supported FM approach is often used in large-scale buildings such as shopping malls, hospitals and airports around the world. This type of use is relatively less common in educational buildings, and similarly, it is not implemented in any university or education building in Turkey. BIM offers accurate, up-to-date and comprehensive 2D-3D spatial and asset data of the facility, reducing errors and costs associated with data entry into FM software. This study sets an example for buildings that may utilize BIM-assisted facility management studies in Turkey.

**Keywords:** Facilities Management, Building Maintenance, BIM, Building Life Cycle

### 1. Introduction

Building Information Modeling (BIM) is commonly used for design and construction in the AEC industry. Its potential in facility management tasks is often neglected. BIM can be used for both space and asset management through 3D AEC models to maintain an up-to-date connection between construction project documentation and the facilities management environment, bringing together all graphical and alphanumeric data of project elements.

\* Corresponding author ([salih.ofluoglu@antalya.edu.tr](mailto:salih.ofluoglu@antalya.edu.tr))

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This study takes the Bomonti Building of the Mimar Sinan School of Fine Arts (MSGSÜ) as a case study to introduce a Building information modeling (BIM) enabled facility management approach. BIM-supported Facility Management (FM) is often conducted in shopping malls, airports, hospitals, educational buildings and public buildings that serve many users and contain a vast amount of space. Facility management models of educational buildings include spaces such as training classes, laboratories, administrative spaces, faculty rooms, food and beverage venues, wet areas, parking areas, warehouses, archives and technical areas. There are some universities using the BIM-supported facility management approach: Texas A&M University, University of Southern California, University of Chicago, Northumbria University, University of Salford, etc. There is no such example in any university in Turkey yet. This study intends to explain the theoretical and standards-based BIM integration process into FM through a practical example.

## 2. Facility management activity and building information modeling (BIM)

Facility management is the maintenance and operation processes of a building with all its assets so that it can be operated efficiently in accordance with its functional purpose. It is a managerial activity that combines people, place and processes (ISO 41001:2018) and accounts for 85% of building life cycle costs (ISO 15686-5:2008). FM covers different service areas such as Asset/Spatial Maintenance Operations, Management Services, Architectural/Engineering Services, Real Estate Affairs, Facility Planning, Financial Planning and Health and Safety. Traditionally these activities are mainly managed by deploying specialized FM software that works with databases consisting of manually entered tables. In most of these environments, there is no integration between the FM data and the 2D/3D graphical project documents.

Building Information Modeling (BIM), which has been widely used in planning and construction processes in recent years, also offers important opportunities in the field of facility management. BIM creates a three-dimensional building model consisting of graphic (geometry/shape, etc.) and alphanumeric (material, cost, physical environmental control data, etc.) data about the building, enabling the use of this model as a common data environment by project stakeholders. This three-dimensional model can be used in processes that include the entire life cycle of the project, such as planning, design, projecting, construction and operations. The building information model includes building elements, spaces and assets that contain useful FM-related data. Some building owners request the updated BIM models for use in facility management activities at the end of a project, particularly in countries where the use of BIM is encouraged by governments (McGraw Hill, 2014).

## 3. The production of building information model for facility management

The Building Information Model and associated documents are important to the facility management process and should be developed taking into account the needs of the owner (also known as the appointing party in the ISO19650 standard) during the design/construction stages. The process of creating Building Information Models is mostly by modeling from the blueprints of the buildings and converting 2D digital vectorial files into BIM files in existing buildings; In new buildings, the project is produced directly with BIM software. BIM models need to be created in relation to each other for different disciplines such as Architecture, Structural and MEP engineering.

Converting the Building Information Model into a BIM model called "As-Built", which reflects the post-construction version of the project, enables working with accurate facility data. The second step is to simplify some technical information regarding the application project in the "As-Built" models and convert the model into an "As-Maintained" BIM model by entering useful spatial and asset parameters for the facility management software. These FM models are also called 7D models.

It is important to decide at what development levels Building Information Models will be created. Although the level of information detail contained in BIM models has differed in new information

management standards (i.e. ISO19650 series and BS EN 17412-1:2020), it is often defined by a method called LOD (Level of Development). There are different levels such as LOD100, LOD200, LOD300, LOD350, LOD400 and LOD500. Models created for facility management are often close to the LOD500 level, which has a high level of alpha-numeric detail, especially for MEP elements. At this level, some numerical and textual information (product manufacturer, warranty information, etc.) are embedded into the graphic elements modeled. In the late stages of the project, asset information consists of more qualitative, alphanumeric data than graphical data (Fig. 1).

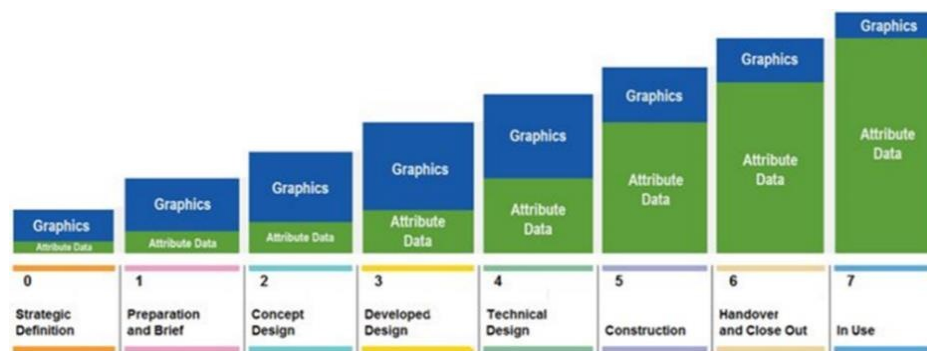


Fig. 1. Change in the need for graphical and attribute data in the building life cycle (BSI, 2014)

## 4. Methodology

This study relies on the simulation/modeling research method. In the process of realizing the MSGSÜ Bomonti building with the BIM-supported facility management approach, the following steps were carried out: (A) Defining the Facility Management strategy for the building, (B) Producing the Building As-built BIM models, (C) Determining the asset and space classification and naming rules, (D) Creating parameters related to assets/spaces and assigning them to model elements and (E) Using building space/asset parameters for facility management purposes.

### A. Defining the Facility Management strategy for the building

Interviews were held with the personnel working in maintenance and repair activities at the MSGSÜ Bomonti building and a preliminary inventory study was produced. A preventative maintenance strategy for the main components of the building was chosen. An on-site review of existing electromechanical elements provided the basis for an as-built BIM model that represents the current conditions of the assets.

### B. Producing the Building As-built BIM models

Architectural, Structural and MEP (electrical and mechanical) models of the building were created from the blend of existing 2D AutoCAD drawings, some blueprints, on-site visit notes and MEK-SİS (T.R. Presidential Strategy and Budget Directorate, Higher Education Venues Investment Decision Support System) data that reflect the current condition of the building's spatial use (Fig.1 and Fig.2). Autodesk Revit was used as BIM modeling software. Two BIM operators was involved in creating the architectural, structural and MEP models. Some irrelevant annotation and dimensioning information from the As-built models were filtered out for facility management usage.

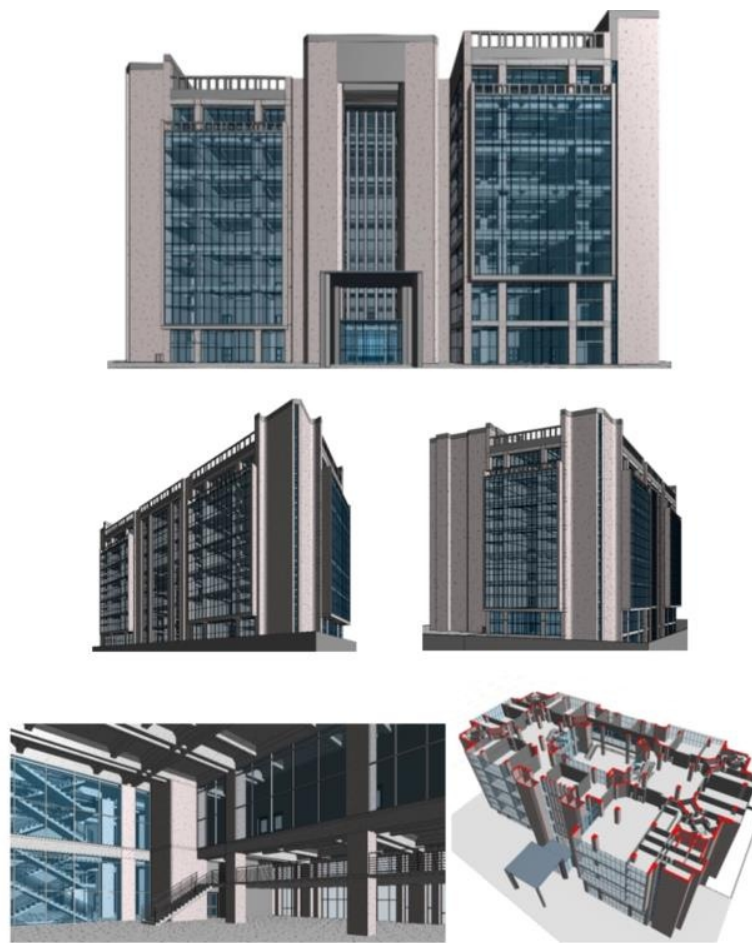


Fig. 2. MSGSU Bomonti building architectural and structural As-Built BIM models

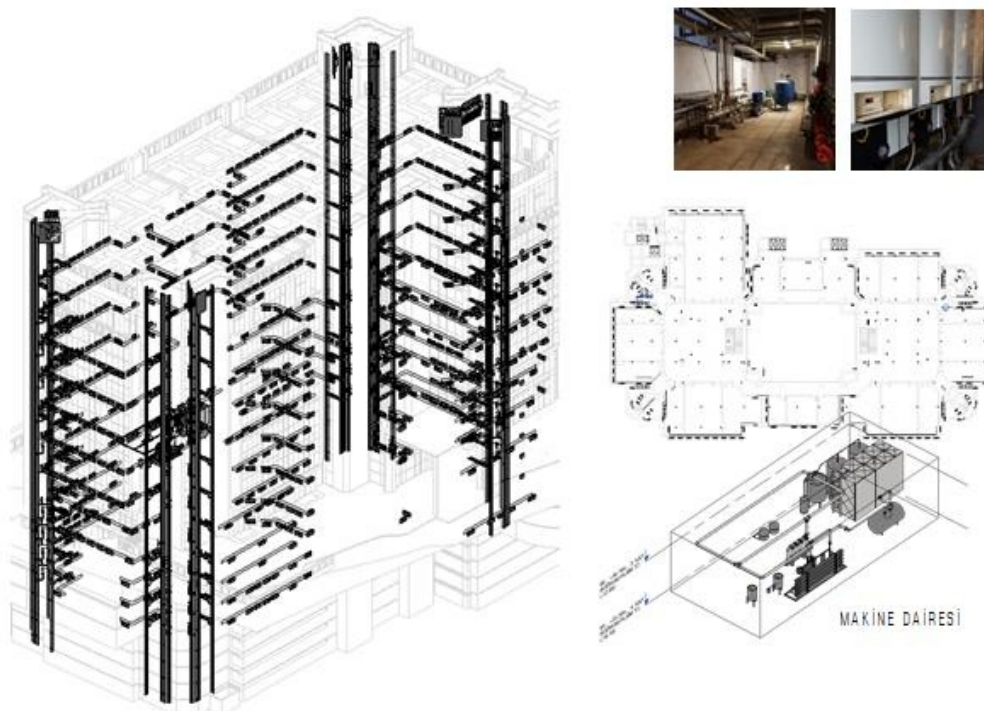


Fig. 3. MSGSU Bomonti building Electro-Mechanical (MEP) As-Built BIM models

### C. Determining the asset and space classification and naming rules

It is important that facility management data is structured according to certain industry standards. The use of a standard for tasks such as grouping assets under the correct category, naming and description reduces data entry errors compared to the use of a de-facto or company-based standard in terms of. Different construction information classification systems were examined in creating the space inventory in the building. There is a lack of Turkish standards to fulfill the needs of the project. Among the existing international standards, OmniClass was preferred because it (1) comprehensively includes facility management elements, (2) works with an object-based logic, and (3) is promoted as a backbone approach for BIM by important organizations such as BuildingSmart and NBIMS (US National BIM Standards) (Fig. 4). OmniClass is manufactured by the US Construction Specification Institute (URL-1). The US National CAD Standard, which is also a widely used standard, is also used in asset naming (URL-2). The naming approach of the GSA (General Services Administration), which undertakes the facility management function of the majority of US public buildings, was largely used for naming building spaces (URL-3).

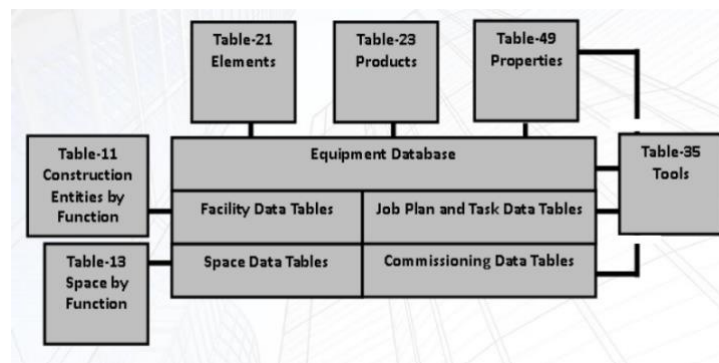


Fig. 4. OmniClass standard-related tables for facility management used in the study

### D. Creating parameters related to assets/spaces and assigning them to model elements

Within the framework of the standards explained above, the following parameters were used for spaces and assets (Table 1). There are various methods for integrating an information classification standard into a building information model and its elements. In this project, Autodesk Classification Manager (URL-4) software functioning on Autodesk Revit was used.

Table 1. Space and asset data parameters used in BIM for FM and associated Omniclass reference tables

Asset parameters			
Equipment_guid	Ekipman_guid	Alphanumerical	
Industry_code_description	Endüstri_kodu_açıklaması	Text	Oc table 23 ve robcad
Industry_code_number	Endistri_kod_no	Number	Oc table 23
Equipment_acronym	Ekipmanın_kısaltması	Text	Ncs ve asme
Equipment_sequence	Ekipman_ardışık_numarası	Alphanumerical	
Equipment_system_description	Ekipman_sistem_açıklaması	Text	Oc table 21
Equipment_system_code	Ekipman_sistem_kodu	Number	Oc table 21

Table. 1.Continued

Equipment_status	Ekipman_statüsü	Multiple choice →	Installed/tested/commissioned
Equipment_manufacturer	Ekipman_üreticisi	Alphanumeric	
Equipment_model_name	Ekipman_model_adı	Alphanumeric	
Equipment_model_number	Ekipman_model_numarası	Alphanumeric	
Equipment_serial_number	Ekipman_seri_numarası	Alphanumeric	
Installed_date	Kurulum_datei	Date	
Spec_unit_1 → n	Özellikler_birimi_1	Text	Oc table 49
Spec_value_1 → n	Özellikler_değeri_1	Alphanumeric	
Spec_unit_2 → n	Özellikler_birimi_2	Text	Oc table 49
Spec_value_2 → n	Özellikler_değeri_2	Alphanumeric	
Warranty_end_date	Garanti_son_datei	Date	
Operation_document	İşletme_dökümanı	Link	
Space parameters			
Space_guid	Mekan_guid	Alphanumeric	
Floor_number	Kat_numarası	Alphanumeric	
Blueprint_room_number	Oda_proje_numarası	Alphanumeric	
Space_use_number	Oda_kullanım_numarası	Alphanumeric	
Space_function	Mekan_işlevi	Text	Oc table 13
Space_code	Mekan_kodu	Number	Oc table 13
Space_description	Mekan_açıklaması	Alphanumeric	

An example implementation of code and space parameters of “Omniclass Table 13 Space by Function” can be seen below (Fig. 5). The same process was repeated for assets (Fig. 6). In this process, “Omniclass Table 21 – Elements”, “Omniclass Table 23 – Products” and “Omniclass Table 49 – Properties” were used in the assignment of asset codes and descriptions. The assigned parameters of some assets belonging to the Bomonti building on the model are listed below. The Revit’s Shared Parameters feature, which allows adding extra features to the standard parameters, was used in the parameter assignment processes of assets.

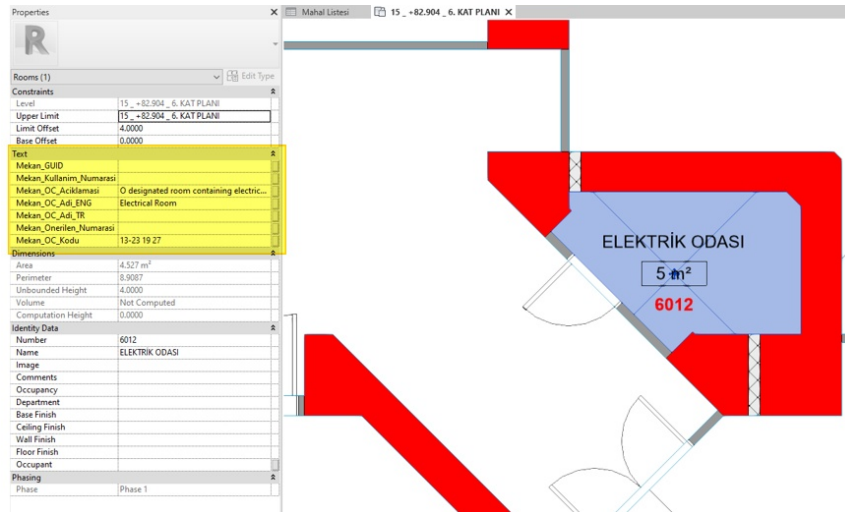


Fig. 5. An example of parameters assigned to spaces

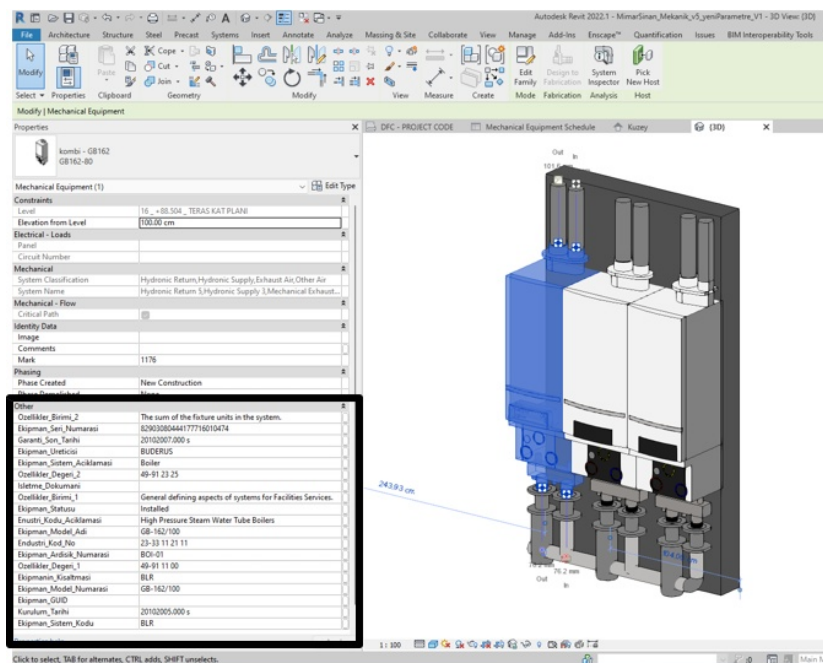


Fig. 6. An example of parameters assigned to MEP entities

### E. Using building space/asset parameters for facility management purposes

Building Information Model data can be shared in open data standards such as IFC and COBie for facility management purposes; proprietary FM software can also be used to work with BIM data. Though COBie data was produced from the model; the commercial software scenario was investigated to assess the effectiveness of the transfer of BIM data. For this purpose, Autodesk's facility management software called BIM 360 Ops was used for its full compatibility with Revit and intuitive interface (URL-5). The software runs in the cloud environment and is a CMMS (Computerized Maintenance Management Software) type facility management software used for asset management purposes. Periodic maintenance of assets, creation of checklists, assignment of technical responsibilities, etc. can be made via the software. Reactive and Preventive maintenance operations can be handled with the software as well. One implementation of space (Fig. 7) and MEP asset (Fig. 8) information transfer from the model to the software are shown below. The transfer process is provided by an Add-On software that allows BIM 360 Ops software to run on Revit.

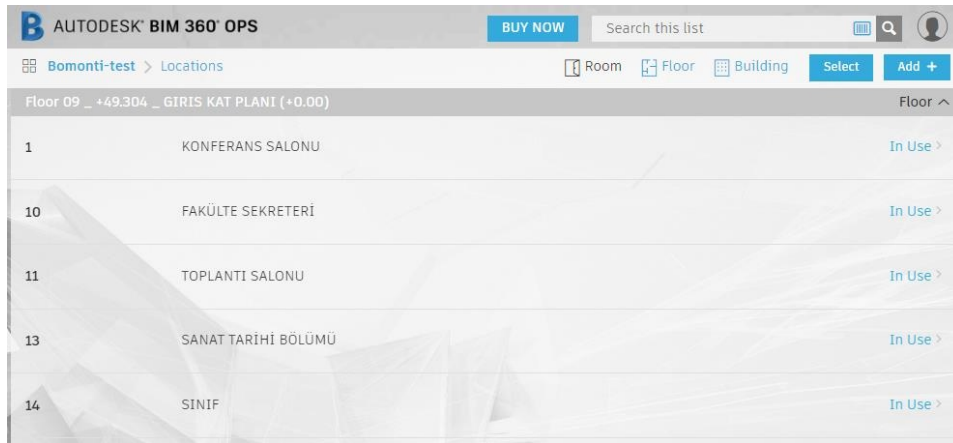
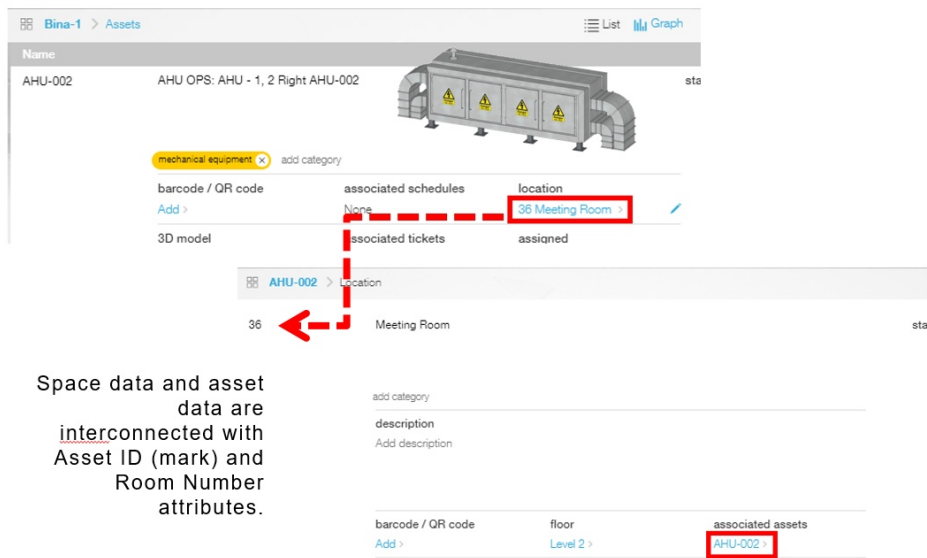


Fig. 7. Space information from the model in the BIM 360 Ops environment



Space data and asset data are interconnected with Asset ID (mark) and Room Number attributes.

Fig. 8. Space and asset relationship in BIM 360 Ops environment

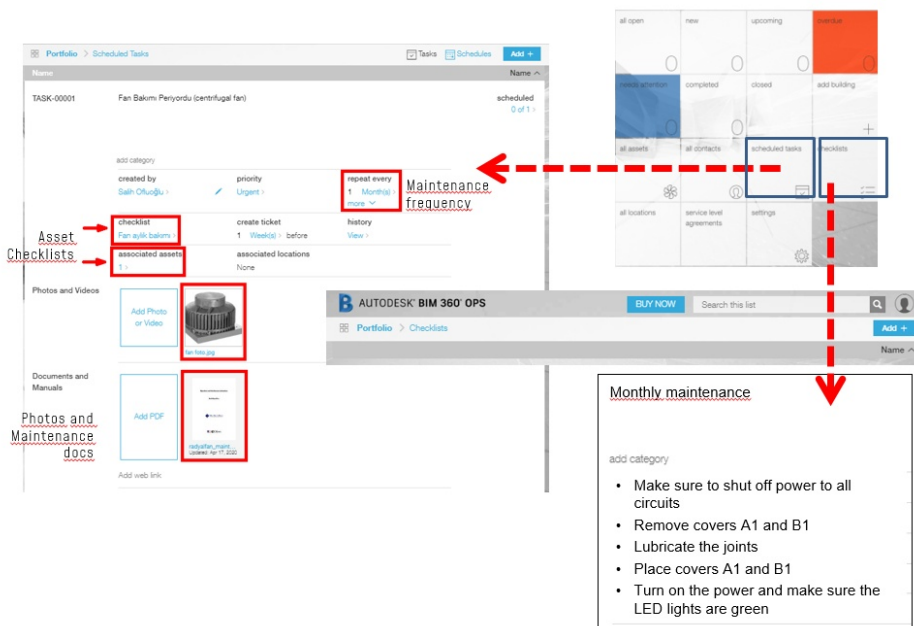


Fig. 9. Creating asset checklists that facilitate the maintenance process in the BIM 360 Ops environment

## 5. Conclusion

The number of resources and applications regarding the BIM-supported facility management process is quite limited. In this work, the steps to be followed in this process were discussed using the MSGSÜ Bomonti building as a case. BIM is widely used in design and construction processes and facilitates interdisciplinary work and information exchange on projects. As explained above, BIM also contributes to the transfer of data required for the operation and maintenance processes of the facility. Data management standards such as ISO19650, which consider BIM as an important element in the digital transformation of the construction industry, encourage the entire project team to consider the information content and format that the owner will need during the operation process from the beginning of the project. For this reason, it is expected that BIM will be used more in facility management processes as this standard series becomes widespread in the coming periods.

It has not yet been possible to apply the models and data produced in this study in the field and test its effectiveness. However, the research has also produced useful outcomes in the educational context. The knowledge generated in the project also fed the "Facility Management with BIM" course launched in the MSGSÜ Architectural and Urban Informatics master's program. Project know-how was also shared with relevant academy and sector representatives at different venues on Real Estate and Facility Management.

## Declaration of conflict interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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