Automatically Updating Maintenance Information from a BIM Database

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ABSTRACT

With the development of building information modeling, knowledge sharing between facility management and design professionals has become possible. The use of building information modeling (BIM) technology in the design and construction phases of buildings is increasing. There is a need to expand the use of BIM beyond the two to three years design and construction phase into the facility management phase of buildings in order to facilitate tasks such as maintenance and to maximize its value to facility owners. However, the fact of current Architecture, Engineering, Construction and Operations (AECO) industry practice is that the facility management phase seldom uses the BIM models even when they are required by the owner in design and construction phase. This fact results in BIM models being wasted where they have the most value, in the facility management phase. This study is a part of the ongoing research of BIM-assisted Facility Management which is aimed to bridge the communication gap between design and facility management professionals. This paper focuses on automatic bidirectional communications between Computerized Maintenance Management Systems (CMMS) and BIM models on a database level.

INTRODUCTION

The AECO industry has shown a good deal of interest surrounding the use of BIM for facility management. The opportunities for leveraging BIM for facility operations are compelling, but the utilization of BIM in facility management is lagging behind the BIM implementation in design and construction phases. On one hand, designers and constructors seldom know what documents and other varieties of information are needed for the facility management phase. On the other hand, a limited degree of knowledge and experience gained in the operation and maintenance phase of these existing buildings is sent back to the design phase. This research is aimed at bridging the communication gap between design and facility management professionals on a facility database level. Since a Computerized Maintenance Management Systems (CMMS) is an important component of the operation and maintenance phase, it is imperative to obtain accurate information, e.g manufacturer information and equipment parameters, needed for the proper operation of CMMS system. The ready availability of such data will reduce the maintenance period and minimize the down time of equipment. Through operations on the BIM database, data can be transferred bidirectionaly between BIM models and the CMMS system. A template that can transfer information bi-directionally between design and facility management software was developed.

LITERATURE REVIEW

Building Information Modeling (BIM) technology has undoubtedly changed the way the AEC industry executes design and construction, but will it also change the way facilities are operated and maintained (Autodesk 2008)? The AECO industry has expressed a good deal of interest in the use of BIM for facility management. The opportunities for leveraging BIM for facility operations are compelling, but the utilization of BIM in facility management is lagging behind the BIM implementation in design and construction phases(Akcamete et al. 2010).

Facility managers are the ones who responsible for the operations and maintenance of the designed and constructed buildings for years. However, there are many organizations and individual professionals involved in these fields. , The leadership of these organizations are beginning to communicate and collaborate, but, to date, have not served the facility and property managers well in the area of BIM (Cotts et al. 2010). On one hand, designers and constructors seldom know what documents and other varieties of information are needed for the facility management phase. On the other hand, a limited degree of experience in the use and operation knowledge of these existing buildings is sent back to design phase for consideration (Jensen 2008). The link between design and facility management is not sufficiently understood and usually avoided (Erdener 2003). Issues related to facility maintenance have been left out of the design decision-making process (Pati et al. 2010).

The operation phase constitutes approximately 60% of the total cost of a construction project. Main activities during operations are related to maintenance and repair (M&R). Reactive maintenance and repairs bring excessive expenses, but it must be remembered that most maintenance work is reactive (Akcamete et al. 2010, Mobley et al. 2008, Sullivan et al. 2010). It is not efficient because reactive maintenance cost three to four times more than the planned maintenance for the same repair (Mobley et al. 2008, Sullivan et al. 2010). So it is reasonable to support more planned maintenance work and not just reacting to failures. Sullivan, et al.(2010) recommended prioritizing the components in a facility, recording root causes of failures and analyzing equipment failure modes etc. in order to capture reliable information for reactive maintenance cost three to four times more than the planned maintenance planned maintenance. A reliable maintenance database holding historical information of maintenance and repair work is necessary for planned maintenance decisions. As significant unnecessary expenses occur in the current practice, there are ample opportunities for major savings in the operation phase; computerized supports are needed for the improvement of operation and maintenance activities (Akcamete et al. 2010).

In addition, the detailed design model is not useful for daily use by facility management. Since design software such as AutoCAD Revit, ArchiCAD etc. are for use by design professionals, requiring facility management staff to use these software packages to query the information they need is both burdensome and inefficient. Only a portion of information from the BIM model is typically required for this purpose.

METHODOLOGY

As shown in Figure 1, the first step of this research is to identify the needs and possible solutions for the requirements of facility management. Existing FM software is examined and interviews have been done with several facility management staff. Although current facility management (FM) software may still have some problems such as not including enough information fields for maintenance work, it is not the focus of this paper. The information required by the FM software and other necessary information are added to the BIM model as parameters. Information needed for the software includes: Location ID, Building, Room Number, Floor, Description, Sq Feet, Requestor, and Phone. Description, requestor and phone should be inputted by the end user and is not related to the BIM models. So those three fields are not considered for parameters. Instead, the name of manufacture, the contact information of manufacture, the location of equipment, the equipment model number, and the warranty expiration date are added to the BIM model as shared parameters.

The BIM tool chosen here is Revit MEP as we focused our problem on MEP system maintenance. The functionality of Revit MEP is investigated to hold the shared parameter, which can be used for multiple projects and exported to external database and a Revit template is built using the parameters created for maintenance purpose. DBLink connections that can export Revit data to external database such as Access were also investigated. A case study of an educational facility is conducted to validate the proposed method for automatically updating information between BIM software and FM software.

CASE STUDY

A case study interview was conducted with the FM information system manager of large owner. The FM manager indicated that they were using an MS Excel file to collect information for equipment from contractors and designers and were using Automaid software to feed the data into their CMMS. The MS Excel format has been used for 14 years. From the CMMS perspective importing the data is already not a problem. This case study is focused on how to populate the MS Excel file from the BIM model automatically for importing into the CMMS software.

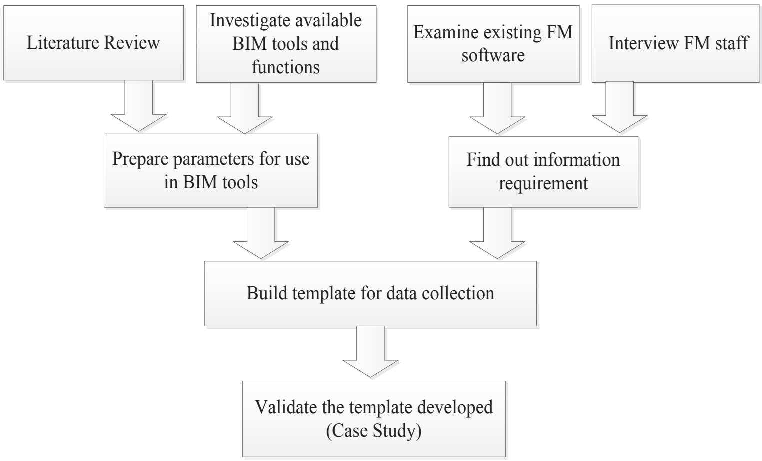

Figure 1. Process for database connection between BIM and FM

Once the required information and data fields have been determined after investigating the existing FM software and interviews with FM staff, the first step would be to prepare the template in Revit and a database export is used to add the required parameters to the Revit Model. Shared Parameters are used here because they can be shared by multiple projects and families, can be exported to ODBC and also appear in schedules. If project parameters are used, the parameter created can only be used for the current project but not shared by other projects. As parameters are set to be used for different projects, shared parameters are more appropriate.

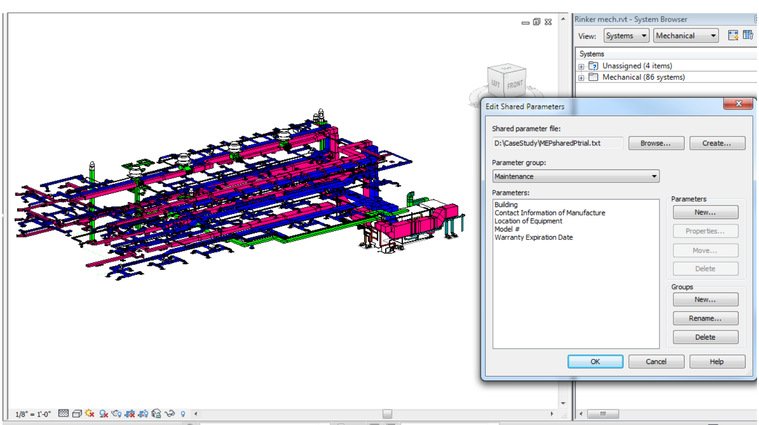

Figure 2. MEP Model and Shared Parameters Editing

Revit allows the user to build a schedule for single or multiple categories, based on the requirement of the end user, different schedule types can be chosen, a multiple category schedule is shown in Figure 3 by using the shared parameters set in Figure 2. Based on the import format that the FM software can accept, the template created in Revit MEP can be saved as an MS Excel file shown in Figure 4 or exported to ACCESS as a mdb file through DBLink as shown in Figures 5 and 6.

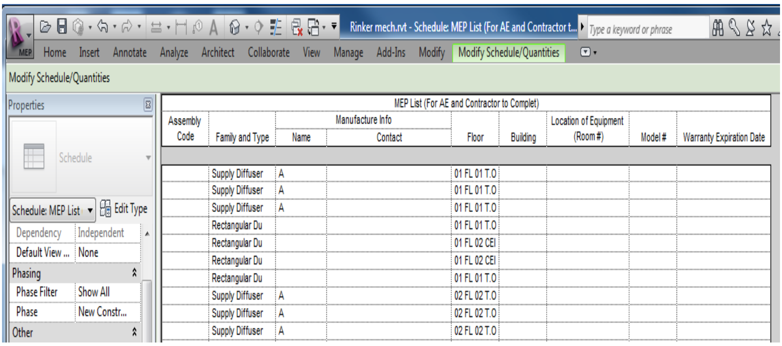

Figure 3. MEP List for Collecting Data in AEC Phase

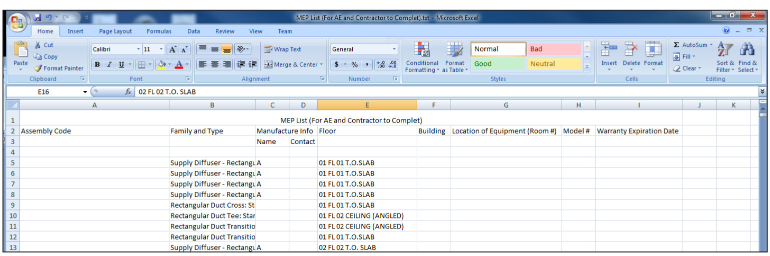

Figure 4. MEP List Export to Excel

Through DBLink, data behind the 3D visualization of the BIM Model can be calculated easily and as the mdb file can be imported back to the Revit model, any changes that happened in the ACCESS can be automatically have the corresponding change to the BIM model after import. In addition, the users can add new fields in the ACCESS database, and the new fields will be the shared parameters in the BIM model (WikiHelp 2012).

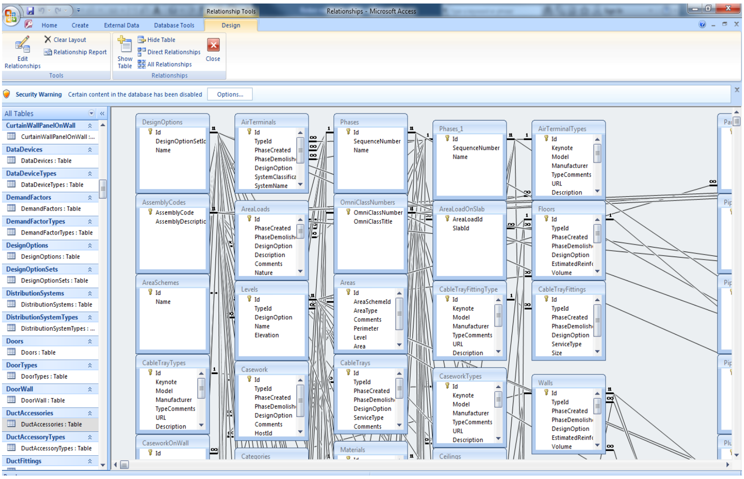

Figure 5. Relationships of Revit Classes

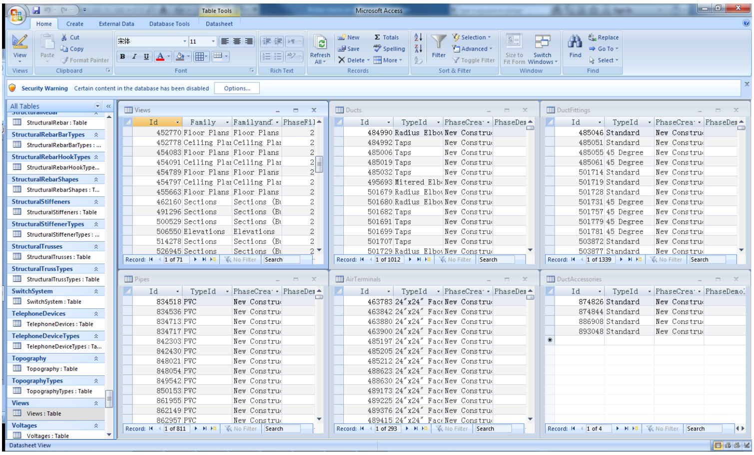

Figure 6. Tables in the Revit Database

Based on what information is needed for the FM software, as we need some more information that the existing FM software that is used by a university, some manipulation of the data field should be edited in the database before import into the FM software system.

CONCLUSIONS AND FUTURE RESEARCH

With the process proposed above, the template is built once in Revit and it can be used repetitively without rebuilding in the succeeding projects if the FM software does not require different data. When the designers and contractors input the required data during the modeling process, the template can be populated automatically and be ready to export.

With the development of building information modeling, knowledge sharing between the facility management and design professionals has become possible. The use of BIM technology in the design and construction phases of buildings is increasing. There is a need to expand the use of BIM beyond the two to three years design and construction phase into the facility management phase of buildings in order to facilitate tasks such as maintenance. The information of a building project that is created and collected in the design and construction phase is valuable for the facility management phase and can help to improve the effectiveness and efficiency of the FM group in operation and maintenance activities. However, the reality of current AECO industry practice is that the facility management phase seldom uses the BIM models even when they are required by the owner in design and construction phase. This fact results in that BIM models are wasted where they would have the most value, in the facility management phase. This paper is a part of the ongoing research of BIM-assisted Facility Management which is aimed to bridge the communication gap between design and facility management professionals. This study focuses on automatically bidirectionally communicating between CMMS and BIM models on a database level. The workflow and case study discussed in this study show that it is possible to automatically transfer information bidirectionally between BIM software and FM software. The storage of FM data in the BIM model can also compensate for the lack of information in current FM software such as cut sheets and 3D visualizations of the work order request, manufacturer contact information and equipment manuals are more easily located for the maintenance work. Future directions of this study may be conducted in querying the required information and fields from the FM software by using Add-Ins or any development by the FM software companies that can make the FM software more compatible with BIM software. As the BIM software package is for design purpose and tends to be expensive, it is not necessary for the FM staff to keep the software itself, if the FM software can contain the necessary information and views from the BIM that are required by the FM staff that would be sufficient for BIM-assisted Facility Management purposes.

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