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Optimizing BIM metadata manipulation using parametric tools

A. M. Khaja, J. D. Seo, J. J. McArthur *

ªDepartment of Architectural Science, Ryerson University, 350 Victoria St, Toronto, ON, M5B 2K3, Canada

Abstract

Building Information Management (BIM) is gaining popularity in the AEC industry for design and construction. Moving into the operations phase of the building, non-geometric information such as indoor environmental quality, and essential building services become increasingly important. The cost of maintaining the information in the BIM model has been a historical obstacle to adoption of BIM during this phase. To overcome this barrier, parametric tools such as Dynamo – often used for developing and manipulating model geometry – have been used to automate the information transfer between the BIM models and facilities management systems. This paper presents a case study investigating this technique, including series of investigations using parametric design tools, APIs and macros to classify, format, manipulate, and assign operations information to BIM elements. This case study demonstrates significant potential for automatic population of this non-geometric data into BIM models and the subsequent improvement for adoption of BIM in the operations phase.

1. Introduction

The use of Building Information Management (BIM) models within the AEC industry for design, and construction is rapidly increasing, however there is a significant disconnect in BIM implementation within the operational phases of a building. Examining current BIM practice through a recent national survey of BIM

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* Corresponding author. Tel.: +1-416-979-5000 x 4082.
  E-mail address: jjmcarthur@ryerson.ca

practitioners saw only 12% of BIM users within the AEC industry pass on the model for use in management of building [1] and less than 10% of BIM models used in building Operations [2]. BIM use for facilities management requires significant non-geometric data to support FM applications such as space management, comfort management, improved inventory management, and energy simulation and conservation [3],[4], as well as the information typically recorded in hard copies and manually entered into the Computer-Aided Facilities Management system(s) (CAFM). Although the benefits of BIM enabled facilities are widely documented [3-6], the cost and time resources and BIM proficiency required to both develop and maintain the BIM model [7],[8],[9] and challenges with data interoperability between the BIM model and existing CAFMs [7], [10] are significant barriers to adoption.

To overcome these challenges, research is underway to explore how parametric tools (such as Autodesk's Dynamo used in this research) can automate model maintenance and data transfer processes, thus reducing set-up and maintenance costs associated with the model. These tools are typically used for physical geometry manipulation within BIM models, however, researchers are beginning to look at the potential impacts of visual programming tools like Dynamo, for their ability to act as linkages for information exchange between the BIM model and external data sources [9],[11],[12]. The proposed approach uses the BIM as a "data consumer" as well as a Common Data Environment (CDE). Using a methodology based on common data formats maintains compatibility with CAFM and maximizes flexibility for future system expansion. The successful implementation of this automation reduces the time required for model upkeep and allows FM personnel to be proactive rather than reactive in maintenance and repair [5]. Given that operations and maintenance accounts for 60% of the overall project cost, the potential impact on time and cost through parametric tools is highly attractive to clients and owners [5]. This paper presents three investigations from a larger case study to develop a BIM in Sustainable Operations model of a campus building in order to demonstrate potential applications of the use of parametric tools such as Dynamo for managing data transfer between the CAFM and BIM CDE. This begins to develop a BIM-based standard approach to push CAFM data into the BIM database, recognized as a necessary development in the field of BIM in FM [13]. Note that while part of a larger case study, the focus of this paper is on the automation processes for data preparation and transfer; a concurrent publication discusses the FM information requirements used to develop – and use the results of – these investigations.

Nomenclature

AEC	Architecture, Engineering and Construction
BIM	Building Information Management
BIM-FM	BIM in Facilities Management model
CAFM	Computer-Aided Facilities Management
CDE	Common Data Environment
FM	Facility Management
HVAC	Heating, ventilation and air-conditioning
HTML	Hypertext markup language
N	Number of owners sharing a space
PDF	Portable document format
SQL	Structured Query Language
TSSA	Technical Standards and Safety Authority – the authority having jurisdiction on elevators in Canada
VBA	Visual Basic for Applications
.xls	Microsoft Excel^{TM} spreadsheet format (alternately, .xlsx)

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2. Case Study Introduction

A BIM for Facility Management (BIM-FM) project to develop a Virtual Campus Model has been under development for Ryerson University, starting with the Kerr Hall East (38% laboratories, 20% classroom, and 10% faculty offices) building, since 2014. This building consists of 201 rooms and other spaces (i.e. stairwells and corridors). This model was developed in Autodesk Revit^{TM} 2015, and interfaces with Archibus – the primary CAFM