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A building information management (BIM) framework and supporting case study for existing building operations, maintenance and sustainability

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Abstract

Building Information Management (BIM) models are transforming how buildings are designed and constructed, and can facilitate multi-disciplinary coordination, and integrate 3D design, analysis, cost estimating, and construction scheduling. By extending the model into the post-occupancy period, BIM models can be used to support Facilities Management and Building Operations, and offer a consolidated interface for information regarding all aspects of building operational performance. Four key challenges must be overcome to develop BIM models suitable for Sustainable Operations management: (1) identification of critical information required to inform Operational decisions, (3) the high level of effort to create new or modify existing BIM models for the building(s), (2) the management of information transfer between real-time operations and monitoring systems and the BIM model, and (4) the handling of uncertainty based on incomplete building documentation. This paper describes the process used to addresses and overcome each of these challenges. The BIM framework and its refinement are presented along with evaluative data from a case study where a model was developed using this framework for a complex university building. The results of this study demonstrate how these BIM models can be developed for the most challenging existing building scenarios and effectively used to improve building management and performance.

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Keywords: sustainability; building information modeling; BIM; facilities management; sustainable operations; data management

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1. Introduction

Building Information Management (BIM) models are transforming how buildings are designed and constructed. BIM is not simply a 3D CAD tool, but is rather akin to a database that allows a wide range of information about the attributes of and relationships between various building elements. The use of BIM in asset management is well-established, however this paper seeks to go beyond the use of construction BIM models in operations and examine the development of new BIM models for existing buildings, presenting a case study and synthesizing a framework. The term "7D" will be used to refer to these models, building upon previous definitions [1-3].

Nomenclature

7D	referring to a BIM model for facilities management / operations
AEC	Architecture/Engineering/Construction industry
BCF	BIM collaboration format
BIM	building information management
CAD	computer aided design
CF&S	Campus Facilities & Sustainability
FM	facilities management
FTE	full-time equivalent staff
H&S	Health and Safety
IFC	Industry Foundation Classes
O&M	operations and maintenance
RRDS	rich room data schedule
RFID	radio frequency identity tag
VDC	Virtual Design and Construction

2. Literature Review

The use of BIM in facilities management and post-occupancy phases of the project is rapidly becoming an area of research focus [4-9]. Particular technologies, such as the use of cloud computing [10], passive RFID tags [9, 11] and 3D scanning [12] have facilitated adoption and added value to BIM in a Facility Management/Operations context. In addition, there has been a substantial effort to interface between BIM models and third-party software [13, 14].

3. Challenges and Proposed Solutions

Four key challenges must be overcome to develop 7D BIM models: (1) identifying the critical information required for sustainable operations, (2) managing information transfer between the BIM model and other FM tools, (3) managing the level of effort to create the model, and (4) handling uncertainty where building documentation is incomplete. Challenges 3 and 4 increase significantly with the decreasing amount of verified digital data.

3.1. Challenge 1: Identification of critical information

The proper identification of the information necessary and beneficial to improve the operational performance of a building is key to the creation of any BIM in Operations model. There is no limit to the types of information that can be incorporated into a model; however much of the information typically included in models is unnecessary for day-to-day operations. Similarly, given the level of effort required to populate a BIM model with operational data, the strategic identification of operational information is critical. This data will vary enormously from project to project based on specific user systems, organizational structure and scope of the model but will be related to one of three rough areas: space planning, maintenance activities, and front-of-house (occupant comfort, sustainability, etc.).