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Enhancing Maintenance Management for Buildings through Building Information Modeling in MENA Region

A THESIS

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Declaration

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Architecture. The work included in this thesis was carried out by the author in the Department of Architecture, Faculty of Engineering, Ain Shams University, Cairo, Egypt. No part of this thesis has been submitted for a degree or qualification at any other university or institution.

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List of Acronyms

BM	Building Maintenance
TBM	Time Based Maintenance
CBM	Condition Based Maintenance
RCM	Reliability Centered Maintenance
RBM	Risk-Based Maintenance
RBI	Risk-Based Inspection
MM	Maintenance Management
BIM	Building Information Modeling
AEC	Architecture, Engineering, and Construction
NIBS	National Institute of Building Sciences
GSA	General Service Administration
MEP	Mechanical, Electrical, and Plumbing
CPM	Critical Path Method
PM	Project Management
EDMS	Electrical Document Management System
ID	Identity
COBIE	Construction Operation Building Information Exchange
IAI	International Alliance for Interoperability
NBIMS	National Building Information Model Standard
IFC	Industry Foundation Class
IT	Information Technology
RFP	Request for Proposal
RFI	Request for Information
GMMS	Global Maintenance Management System
CMMS	Computerized Maintenance Management System
FUSS	Facilities and Construction, Utilities, Safety and Security Administration
BSL	Biological Safety Lab
WO	Work Order
O & M	Operation and Maintenance
FMOC	Facility Maintenance and Operations Committee
OMSI	Operations and Maintenance Support Information
UFGS	Unified Facility Guide Specifications
NIST	National Institute of Standards and Technology
GIS	Geographic Information System

Abstract

Building maintenance and management are two sides for the same coin, which keep a building with the best quality during its life cycle time. Building management plays a role in covering the basic lines of security, cleanliness and implementing maintenance plans to reach the best performance and efficiency.

Maintenance management has become one of the most important factors that help complex buildings to perform effectively. As a result, buildings life span has dramatically increased especially when using recent technology. Maintenance management has become more powerful where building information modeling (BIM) helped in making standards that allows maintenance managers to make sure that every component in the building is working effectively.

However, four major steps in this thesis were done to help in generating a recommended framework that could help AEC firm in future. Where, analyzing theoretical data from literature reviews in fields of building maintenance, maintenance management and BIM will take the first place. While, thesis scope focuses on 7D services of BIM dimension which is related to maintenance management and construction operation building information exchange (COBie).

Thus, spotting the light on two of COBie applications and how using COBie standard and integrating it with maintenance management is an effective tool. Furthermore, a questionnaire survey was done with nearly 40 persons at the consultancy, contracting and real estate companies to know how far BIM is spread in Egypt and COBie familiarity and knowledge.

Finally, A sample was selected for a one-to-one interview with experts to cover BIM spread and COBie knowledge in MENA region. Consequently, this thesis recommends a framework for reducing cost, time and resources for complex buildings. The framework will integrate maintenance management, BIM and COBie standard by computerizing construction handover documents and by explaining how rules and guidelines can improve the enhancement of maintenance management. Furthermore, this framework needs to be further verified in future researches.

Keywords

Building Maintenance, Maintenance Management, Building Information Modeling, Construction Operation Building Information Exchange.

Introduction

Statement of the Problem

As per previous researches ,operation and maintenance costs currently account approximately 55% of the total cost (Flanegan and Norman, 1989), while the cost of operating and maintaining a facility represents approximately 85% of the total cost of ownership, then decreased till it reached a range of 50-70% (Teicholz E., 2001).

Where the main problem that is tackled through this thesis is the lack of coordination between the designer, constructor, contractor, maintenance staff and managers “the stakeholders” involved in the phases of constructing and operating the building. This problem includes technical, management and administration, financial, spare parts and proper training for the employees. This could lead to waste time, increase running cost and reduce proficiency of a building during delivering data from construction to operation phase, which may be not updated, confused, insufficient or even very large according to a lot of modifications. (Njabulo B, 2018)

Many companies are still working with traditional databases such as manual documentation handover protocol between construction and operation phases. When a modification is needed, for example, the number of revisions done in drawings and site correspondence documentations, simultaneously, increase. This leads to stacking huge quantities of documentation in the form of papers which makes it hard to find the exact data needed, and hence, it wastes valuable working hours. As a result, employees tend to solve the problem by increasing the number of workers which may increase the indirect cost of the project. Thus, there is a need for such a framework.

Many construction firms have cited traditional manual documentation as one of the most challenging tasks performed in the delivery process for buildings. There are many challenges with the traditional manual documentation some of which include the following:

- Lack of ability to identify specific information needed.
- Waste of time and resources during the expulsion of information.

- Delays in the maintenance process due to the conflict being identified on-site.
- Overall reduced productivity for everyone involved in the process.

As a result of these problems with current technological processes, the product of documentation does not fully satisfy the objectives of any of the project participants. (Albrice D, 2016)

Research Aim

The main objective of this research is to generate an adaptive framework that could be implemented on construction buildings in MENA region, it will increase the performance of maintenance management and interoperability through improved integration with building information modeling standard (COBie). Also, it will help in providing several solutions which satisfy stakeholders, especially maintenance managers and their teams. In addition, many advantages will come out of this integration by clarifying and organizing the maintenance process through the lifetime of a project.

Furthermore, it spots the light on identifying the most optimum building maintenance type and its procedures which help in increasing the lifetime of project components and reduce the cost of maintenance budget. Also, integrating building information modeling with maintenance management helps in achieving high rates of efficiency and quality of the components of a project. Where BIM simulates a virtual model that can help to show problems and conflicts that may appear during the construction phase and its standard focuses on producing accurate and specific database consisting of all the required information.

Thus, integration between maintenance management, BIM and COBie standard is expected to mitigate the root causes of the problem. This leads to a reduction in cost and time. In addition, COBie standard will create a database for specific information of every component in a building. Therefore, it could help different stakeholders and organize their process through the following procedures:

- Shorten the duration of getting the information needed from maintenance database and schedules.
- Lowering the cost of the maintenance process in a project.
- Knowing types of maintenance, procedures and strategies.
- Usage of Building Information Modeling (BIM) to support AEC firm.
- Computerizing the information gathered during different phases of a project by using COBie standard.
- Linking COBie standard with the international market to ensure having the best performance and quality without wasting time or preventing the building from applying its function.
- Evaluating COBie applications to know its limitations and effect of integrating it with maintenance management.
- Designing a framework that integrates MM with BIM and COBie.

Research Methodology

To achieve the aim of this thesis, a variety of references and sources have been reviewed and analyzed, which are related to the field of building maintenance, maintenance management, BIM system, COBie standard and analyzing the applications of COBie to show how integrating it with the maintenance management is an effective tool in mitigating the problem of the research.

Furthermore, a questionnaire survey was done with nearly 40 persons concentrating on engineering companies such as consultancy, contracting and real estate companies, in order to know how far BIM is spread in Egypt, followed procedures and protocols, scale of projects they use BIM in it, its effectiveness on each phase and familiarity with COBie standard.

Moreover, a one to one interview was done with a selected 8 foreign experts in order to know how far the process of BIM is implemented in MENA region, the scale of projects they use in it, obstacles facing them and their knowledge and implementation for COBie standard.