Eighth International Conference on Construction in the 21st Century (CITC-VIII) "Changing the Field: Recent Developments for Future Engineering and Construction" May 27-30, 2015, Thessaloniki, Greece

The Adoption Building Information Modeling in Construction Industry in Libya: A Developing Country Context

Ahmad Amer
University of Elmergheb in Al-khoms, Libya

Zulkifili Hanafi
Infrastructure University Kuala Lumpur, Malaysia

Abstract

Buildings and associated processes are now becoming increasingly required to be delivered and implemented in a sustainable manner. Information Technology (IT) has revolutionized the building design and the adoption of advanced modeling technologies in building design. One of the latest technologies is building information modeling (BIM) .This study identifies through literature review the key factors affecting BIM adoption. This study aims to propose a model that examines these factors that affecting the level of adoption and concerning the details involved in BIM for design construction in Libya; and validates the model for construction organisations in Libya using questionnaire survey. This model will be tested using structural equation modelling (SEM). This model is expected to give guidelines for engineers, designers, developers and practitioners
.

Keywords:
Adoption, building information modeling, design, Libya

1. Introduction and Background

In the last two decades, Information Technology (IT) has revolutionized the building design and the adoption of advanced Computer-Aided Design (CAD) modeling in building design has made the final products more efficient and less costly since it provides the data needed for building performance analysis and evaluation as design on the project proceeds (Nguyen, Shehab and Gao, 2010).

According to a survey from American Institute of Architects (AIA), Building Information Modeling (BIM) technology experienced a 160% increase in use by the mainstream architectural community between 2005 and 2009. Even though, many problems are associated with the adoption of this technology, particularly in developing countries. The use of BIM requires more than the adoption of its technology by one group in the architecture, engineering, and construction industry. Despite an increase in the software's adoption, the construction industry is still experiencing barriers with BIM.

Building Information Modeling (BIM) has emerged from three-dimensional (3D) architectural design technology to a comprehensive 'methodology to manage the essential building design and project data throughout the building's lifecycle' (Penttila¨, 2006). The knowledge domain of BIM is expanding with its implementation in many countries in the conceptualization, design, construction and operation of the buildings. In this article, a review of BIM initiatives for its implementation in a number of countries is presented. Such initiatives can be categorized with respect to the type of main stakeholders taking initiatives, such as the public and private sectors, as well as by the class of initiatives. BIM initiatives have been classified into the policy, process and technology fields (Succar, 2009). This paper aims to examine the factors affecting the adoption of BIM among construction industry in Libya.

2. Literature Review

The National Institute of Building Sciences defines BIM as the utilization of cutting edge digital technology to establish a computable representation of all the physical and functional characteristics of a facility and its related project/life-cycle information, and is intended to be a repository of information for the facility owner/operator to use and maintain throughout the life-cycle of a facility (Ashcraft, 2008). In addition, According to American Institute of Architects, BIM is defined as a model-based technology linked with a database of project information, which can be accessed and shared among different project participants (Lee, Sacks and Eastman, 2006).

The pursuit of sustainability has become a mainstream building design objective. In 1987, the Brundtland Commission offered the following widely accepted definition of sustainability, "Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Using BIM may change the regime in which decisions are defined and permitted in line with progressive sustainability goals but there is a significant need to understand BIM as a 'systemic' (Taylor & Levitt 2004).

The concept of BIM has existed since the 1970s. Eastman, and Teicholz (2011) mentioned that the term BIM first appeared in a paper by van Nederveen and Tolman(1992). However, the terms Building Information Model and Building Information Modeling (including the acronym "BIM") had not been popularly used until Autodesk released the white paper entitled "Building Information Modeling". As a common name for the digital representation of the building process as then offered under differing terminology by Graphisoft as "Virtual Building", Bentley Systems as "Integrated Project Models", and by Autodesk or Vector works as "Building Information Modeling" to facilitate exchange and interoperability of information in digital format.

It would appear that BIM enabled construction work has come closest to a mandated collaborative working methodology; facilitating the redesign of organizational functions and processes toward integrative design, multiple stakeholder collaboration, common goal-setting, the quick efficient presentation of complex concepts to enable fast and effective decision-making, and an emphasis on dialogue between stakeholders (Ahmad et al. 1995). Aspects of working methods that are purportedly required to meet already established BREEAM assessment criteria and a paradigm shift in the approach to sustainability advocated by many commentators (Du Plessis & Cole 2011; Cole 2011; Cole 2012).

There is a remarkable shortage of studies on BIM in developing countries as most research has been conducted in developing countries such as UK, Australia and European countries. To the best of the researcher knowledge, there is a lack of theoretical models that investigate factors affecting BIM. Currently there is no specific research that operationalizes together with performance the selected factors affecting the implementation of BIM technology. This study will provide empirical evidence by validating a model that examines these factors. The building industry is a well-known latecomer to the productivity advantages offered by technology. Manufacturing, agriculture, and finance, like most modern enterprises, have embraced information technology for competitive gain, efficiency, and new approaches. Most methods of building project delivery are optimized for least cost and least exposure to each player in the process, to the detriment of the overall result. Legal, insurance, and financial systems have reinforced this focus on least cost and exposure and calcified inefficient delivery practices. Ultimately, building owners bear the brunt of these inefficiencies as the party most impacted by construction errors, broken schedules, and budgets, as well as high long-term operational and maintenance costs.

3-Proposed Model and Hypotheses

It is generally assumed that attitude and behaviour of managers can play an essential role in the performance at work. However, it should be examined from different angles. Identifying these variables in the proposed model can help improve the EM usage in developing countries, where there is a remarkable lack of similar technology adoption studies, particularly EM related technology. Hence, in an attempt to fill the research gap, the present study is initiated to identify the factors which affect the intention to use the EM in a developing country context.

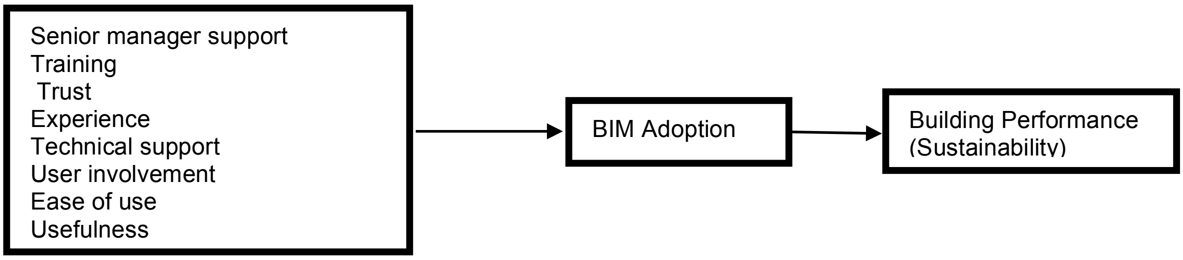

Figure 1. Proposed Model

Table 1: Summary of Hypotheses

Variable	Hypothesis	Direction
Top manager support	There is a positive relationship between top manager support and BIM adoption	Positive
Training	There is a positive relationship between training and BIM adoption	Positive
Ease of use	There is a positive relationship between ease of technology use and BIM adoption	Positive
Technical support center	There is a positive relationship between technical support center and BIM adoption	Positive
Level of education	There is a positive relationship between and BIM adoption	Positive
Age	There is a negative relationship between level of education and BIM adoption	Negative
Technical knowledge	There is a positive relationship between technical knowledge and BIM adoption	Positive
BIM adoption	There is a positive relationship between BIM adoption and building performance	Positive

3. Concluding Remarks

For theory, the objective of this paper is to develop a conceptual framework on the adoption of BIM among construction organizations in Libya as an example of developing countries. The research model presented in Figure 1 was built based on technology acceptance studies in both developed and developing countries. For practice, the framework is useful as a guide for engineers and project managers in organizations to focus on new possibilities of performance improvement through the expected usage of BIM. An extensive adoption of BIM not only increases a firm's awareness of opportunities for undertaking competitive actions, but also allows the company to achieve greater enhancement on its ability and responding quickly to the dynamic changes of the competitive environment within the context of building performance.

References

Nguyen, T. H., Shehab, T., & Gao, Z. (2010). Evaluating sustainability of architectural designs using building information modeling. The Open Construction and Building Technology Journal, 4(1), 1-8.

Penttila¨, H., 2006, 'Describing the changes in architectural information technology to understand design complexity and free-form architectural expression', Journal of Information Technology in Construction 11 ,(Special issue, The Effects of CAD on Building Form and Design Quality),395 – 408.

Succar, B., 2009, 'Building information modeling framework: A research and delivery foundation for industry stakeholders', Automation in Construction 18, 357 – 375.

G. Lee, R. Sacks and C. M. Eastman, "Specifying parametric building object behavior (BOB) for a building information modeling system", Automation in Construction, vol.15, no. 6, pp. 758-776, 2006.

WCED (1987), Our Common Future, Oxford University Press, Oxford and New York, NY. Zimmermann, M., Althaus, H.J. and Haas, A. (2005), "Benchmarks for sustainable construction: a contribution to develop a standard", Energy and Buildings, Vol. 37 No. 11, pp. 1147-57.

Taylor, J & Levitt, R (2004) Understanding and managing systemic innovation in project-based industries. Innovations: Project management research, 1–17.