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Awareness and challenges of building information modelling (BIM) implementation in the Yemen construction industry

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Abstract

Purpose – This paper aims to investigate the awareness of construction practitioners of the adoption of building information modeling (BIM) and identification of the dominant challenges of implementing BIM in the life cycle of a construction project.

Design/methodology/approach – This study was sequentially conducted in the following in three main phases: a preliminary study of archival literature, where a rigorous study of the literature was conducted to identify the challenges of adopting BIM in the construction industry which was to be applied later to the challenges in the case of the Yemen construction industry; data collection, where data were collected using a questionnaire survey targeting 123 Yemeni construction practitioners working in managerial and technical levels; and data analysis, where data were analyzed using descriptive analysis by calculating the average index and standard deviations. The data were analyzed using the SPSS software.

Findings – The results show that the most critical challenges to adopt BIM are financial restrictions, lack of BIM knowledge, improper introduction of BIM concepts, lack of awareness of BIM benefits and no governmental enforcement. The study recommends policymakers and construction players to consider the challenges for a better introduction of BIM in the Yemen construction industry.

Research limitations/implications – This research focuses on the awareness and challenges of implementing BIM in the Yemen construction industry.

Practical implications – The findings of this study will help policymakers develop more constructive strategies to reduce the challenges and introduce governmental agendas towards the widespread use of the BIM concept and technology in the Yemen construction industry. The study suggested an in-depth investigation into the current curriculum in the Yemen universities and recommended the introduction of BIM concept in engineering courses.

Social implications – This study focused on the challenges of implementing BIM and the role of the social aspect in the issue.

Originality/value – From the extensive review of previous findings, this paper concentrates on the challenged to the implementation of BIM in the Yemen construction industry. There are lack of investigative studies that focus on the introduction of new technologies to advance the Yemen construction sector. Therefore, the findings help the authority to diagnose and address the sources of these challenges and introduce new solutions to the industry.

Keywords Awareness, Construction industry, Challenges, BIM, Yemen

Paper type Research paper

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Introduction

The construction industry is the major growth driver of Yemen economy (Sultan, 2005). The government has established several initiatives and strategies to transform the industry and expedite its momentum in order to develop and expand the urbanization and improve the lifestyle of Yemeni nationals. The Ministry of Public Works and Highways is the governing agency that administers and manages the construction industry (Najib *et al.*, 2018). Despite the political unrest since the Youth Revolution in 2011, the construction industry is progressing slowly to accommodate the housing demands of the people. However, the traditional construction practices are predominant and rife, and till date, construction practitioners remain unaware of the advantages of using advanced concepts and technologies to substitute the current practices (Gamil and Abdul Rahman, 2018).

Over the past years, project delivery and monitoring were major challenges in the construction project, characterized by being fragmented and multifaceted and involving several parties in a single project; therefore, it became necessary to introduce an integrated concept to integrate all parties (Kerosuo *et al.*, 2015). Building information modelling (BIM) is a modern technology adopted in the construction industry (Autodesk Inc., 2018). It is an integrated and complete tool to administer construction projects in both management and technical aspects (Tahir *et al.*, 2018). It brings all construction stakeholders into one effective platform (Azhar, 2011; Yaakob *et al.*, 2016). BIM is not only a technological facility but also a concept practice bound with advanced technology to produce effective project delivery (Criminale and Langar, 2017). It uses information and communications technologies to improve progress monitoring, improve efficiency and enhance productivity and quality (Hamid *et al.*, 2018). Although BIM technologies have been practiced in many countries since the early 1980s, there remain countries that have till date not considered or appreciated the important benefits of implying BIM in project delivery and execution, and the interference of socio-technical issues that undermine the application of BIM adds to the existing issues (Diaz, 2016; Ku and Taiebat, 2011). Yemen is one among the countries that have not yet developed or launched any agenda or initiative to apply BIM in construction projects because of many challenges and impediments.

The introduction of BIM technology is associated with many challenges and impediments which slow the process of implementing BIM in construction projects. One of the most common issues is the fear of outcomes generated by BIM, especially to new users, and the low satisfaction of its results (Diaz, 2016). Mainly, the challenges can be clustered based on the concept of BIM to process related challenges, technologies and policies. There are many other challenges that hinder the application of BIM in the construction industry. In Malaysia, the most critical challenges of using BIM include the high cost of technology, lack of knowledge on BIM and unavailability of BIM training (CIDB, 2016). However, Hamid *et al.* (2018) found the most critical barriers of adopting BIM in Malaysia's interior design industry include financial barriers, lack of BIM knowledge and lack of awareness. Similarly, in the Indian construction industry, Meganathan and Nandhini (2018) found that the high cost of software, low demand from clients, inadequate project experiences, management process change difficulties, inadequate top-management commitment, unclear legal liabilities and lack of skilled and trained employees are the main challenges of accepting BIM. In Sweden, the most dominant challenges to applying BIM include changing work practices, providing education and learning, developing a mutual BIM definition, evaluating the business value of BIM, demanding BIM in procurement, creating incentives, including maintenance department, creating new roles and managing interoperability (Vass and Gustavsson, 2017). In Saudi Arabia, the most critical challenges of introducing BIM are the lack of knowledge of the BIM adoption process, the lack of support from managers to accept changing current practices and

the lack of practical standards and guidelines in addition to the lack of attention by policymakers and the government (Alhumayn *et al.*, 2017). In the UK construction industry, the critical challenges to implement BIM are the lack of understanding by clients concerning requirements for the BIM model, the lack of learning feedback from projects on which BIM has been used and the lack of supply chain integration (Navendren *et al.*, 2014).

BIM is a collaborative process that introduces many advantages to improve project quality and delivery (Diaz, 2016). It improves the predictability of project performance and operations by providing virtual designing and smooth monitoring processes (Azhar, 2011). There are many benefits and potential advantages of adopting the BIM concept. The following are few of the benefits:

- *Effective process*: BIM integrates all the relevant parties; therefore, project information is easily accessed and shared which will expedite the process (Hamid *et al.*, 2018).
- *Effective communication*: Communication is easily performed among construction parties (Succar, 2009).
- *Effective progress monitoring*: BIM helps project managers assess the progress on site by having visual monitoring between what has been executed on site and what is remaining to be completed (Hamid *et al.*, 2018).
- *Better project performance and quality*: Safety, cost- and time-efficiency are major performance indicators, and BIM helps improve these indicators for the success of projects (Succar, 2009).
- *Improve visualization of project execution*: BIM incorporates many dimensions such as time and cost, which helps the users visualize the process on site, concurrently monitoring the cost and time of each project activity (Haron *et al.*, 2015).
- *Improve construction planning*: BIM simplify the planning process because it produced visualized concept of the project activities and execution (Rogers *et al.*, 2015).
- *Minimize dispute among construction parties*: BIM unfolds all the dispute causes and improves transparency and communication, which helps avoid occurrence of dispute (Azhar, 2011).
- *Improve collaboration among construction parties*: BIM integrates all project disciplines and produces more effective collaboration and cooperation (Kerosuo *et al.*, 2015).
- *Improve decision-making process*: BIM presents a complete image of the real execution of the project which facilitates decision-making (Azhar, 2011).
- *Improve forensic analysis*: Related information can be easily accessed to retrieve the sources of failures and flaws (Azhar, 2011).

Despite the numerous benefits introduced by adopting BIM, it is still not appreciated by the policymakers and the construction companies in Yemen as a method of project execution. Many companies believe that shifting from the current practice to using BIM will cost them and they will encounter difficulties in its implementation. This study attempts to unveil and discover the awareness and challenges of using the BIM concept in the Yemen industry and measure the acceptance level of BIM adoption in the Yemen construction industry.

Methodology

This study was sequentially conducted using the following three main phases:

(1) *Preliminary study of archival literature*: A rigorous study of the literature was carried out to identify the challenges of adopting BIM in the construction industry, which was to be applied later to the challenges in the case of the Yemen construction industry.

(2) *Data collection*: Data were collected using a questionnaire survey targeting 123 Yemeni construction practitioners working in managerial and technical levels.

(3) *Data analysis*: Data were analysed using descriptive analysis by calculating the average index (AI) and standard deviations (Std). Data was analysed using the SPSS software.

Data analysis

This part consists of three main items which include the demographics of participants, awareness analysis and the challenges of BIM implementation.

Respondent demographics

The first part was to collect participants' demographic information, including their categories of the company, designations, qualification, years of experience and types of organization activities (consultant, contractor and client). Table I shows participants' demographic data.

The questionnaire targeted Yemenis who were working in the construction industry. From the results, it was determined that participants were from different departments of companies and were taking part in different business activities. Most of the participants held bachelor degrees and had been working in the construction industry for more than 10 years, and this indicated why they were included in this study, and their inputs were significant for the data collection.

Table I. Participants' demographic profile

Items	Variables	Frequency	(%)
Category of company	Private	93	75.61
	Governmental	24	19.51
	Others	6	4.88
Designation	Company director	17	13.82
	Project manager	35	28.46
	Architect	12	9.76
	Civil engineer	41	33.33
	Quantity surveyor	15	12.20
	Others	3	2.44
Organization activity	Consultant	53	43.09
	Contractor	66	53.66
	Client	4	3.25
Qualification	High school	2	1.63
	Diploma	19	15.45
	Bachelor degree	85	69.11
	Master degree	13	10.57
	PhD	4	3.25
Years of experience	0-10	34	27.64
	11-20	61	49.59
	21-30	19	15.45
	31 and more	9	7.32

Awareness of BIM implementation

Studying the awareness of BIM implementation takes precedence to understanding whether the technology application is of concern to construction organizations. The first part aimed to study the awareness level of Yemen construction practitioners of the BIM technology and concept. Three questions were introduced to the participants, which are as follows:

(1) Does your organization imply BIM concept and technology in project design and implementation?

(2) Is your organization aware of the benefits of using BIM?

(3) Is your organization planning to imply BIM?

Figure 1 indicates the response analysis for questions highlighted to respondents on the awareness of BIM application. It is shown that most of the companies have not yet applied BIM in their projects; however, there is a noticeable percentage of the awareness to BIM benefits. As an overall finding, the Ministry of Public Works and Highways is responsible for launching a campaign to increase the awareness of BIM benefits among construction practitioners.

Challenges of BIM implementation

The second part of the questionnaire intended to solicit respondents' opinion on the assessment of challenges hindered to BIM adoption in Yemen construction. The challenges were determined from previous literature studies and were grouped to different clusters to present more understandable and articulated concepts of the challenges.

Table II shows the BIM implementation challenges in the Yemen construction industry and their ranking. Four categories, namely, challenges related to technology, people, processes and governmental challenges, were considered. It is indicated that the most important factor related to technology is the high cost of technology (4.510), and this is justified due to the financial limitations; however, the most significant factor related to people-related challenges is the lack of BIM knowledge (4.648) attributed to the late introduction of technology and unavailability of curricula related to BIM in Yemeni higher institutions. Regarding the process-related issue, financial restriction (4.671) is the most prevalent challenge according to the participants. The final group is governmental

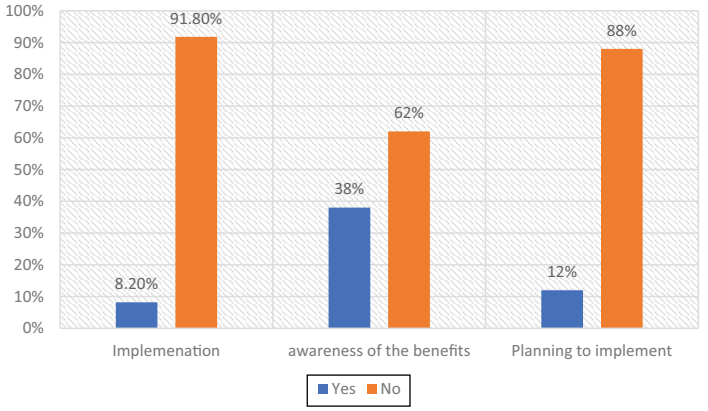

Figure 1.
BIM awareness in the Yemen construction industry

Categories	Challenges	Std	AI	Category-based ranking	Overall ranking
Technology	Expensive cost of technology	0.816	4.510	1	8
	Unavailability of BIM training	0.938	4.401	2	13
	Complexity of BIM technologies (software)	1.010	4.391	3	14
	Requirement of high-spec computers	0.981	4.210	4	21
People	Lack of BIM knowledge	1.02	4.648	1	2
	Lack of awareness of BIM benefits	0.891	4.621	2	4
	Lack of BIM expertise	1.01	4.572	3	6
	Reluctance to hire BIM experts	1.02	4.487	4	9
	Fear of the outcomes	0.971	4.473	5	10
	Reluctance to change to BIM	0.921	4.281	6	19
	Lack of collaboration among parties	1.03	4.22	7	20
	Immigration of skilled experts	1.02	4.182	8	23
	Lack of support from top management	0.941	4.037	9	24
Process	Financial restrictions	1.021	4.671	1	1
	Improper introduction of BIM concepts	1.09	4.632	2	3
	Unwillingness to try BIM process	1.051	4.521	3	7
	Lack of experience	0.973	4.472	4	11
	Unfamiliar with BIM process	0.98	4.439	5	12
	Difficulty to change current management process	1.072	4.336	6	15
	Improper interoperability between traditional methods and BIM	0.863	4.322	7	18
	lack of BIM demand	0.884	3.93	8	25
	Lack of time to implement	1.001	3.425	9	27
Governmental	No-governmental enforcements	0.942	4.603	1	5
	Lack of national agenda	1.012	4.331	2	16
	Lack of standardization	1.03	4.326	3	17
	lack of governmental legislation	1.002	4.201	4	22
	Lack of support and motivation	1.022	3.833	5	26

Table II.
BIM implementation challenges in Yemen

challenges, and the most dominant factor is no governmental enforcement on construction firms to apply BIM.

As an overall ranking among the 27 challenges identified in Table II, the top-ranked five challenges based on the descending AI are financial restrictions, lack of BIM knowledge, improper introduction of BIM concepts, lack of awareness of BIM benefits and no governmental enforcement.

Conclusions

BIM as a collective process consists of concepts and technology which help transform the traditional practice of executing projects to a better-revolutionized and -visualized concept, and it integrates all project disciplines. The study uncovered the awareness standpoint and challenges to implement BIM in the Yemen construction industry. The challenges have been identified and assessed using AI and Std. From the results obtained, the construction organizations in Yemen are not yet ready to accept BIM as a concept of project execution owing to the organizations' low level of preparation and potentials to introduce this technology. The findings of this study will help policymakers develop more constructive strategies to reduce the challenges and introduce governmental agendas towards the widespread use of the BIM concept and technology in the Yemen construction industry. The

study suggested an in-depth investigation into the current curriculum in the Yemen universities and recommended the impeding of BIM in engineering courses.

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