# Challenges to the Utilization of BIM in the Palestinian Construction Industry

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**Abstract –**

**This Building Information Modelling (BIM) is considered an innovative method to design, construct and manage a building. BIM can reduce time, cost and enhance project quality. The study reported in this paper was aimed at identifying and evaluation challenges that are facing the application of BIM in the Palestinian construction industry. A total of 270 professionals were surveyed to elicit their views regarding challenges to the utilization of BIM in the construction industry. Factors were ranked according to their relative importance index through SPSS version 22. The results of this study revealed that the main challenges to the utilization of BIM were: lack of awareness of BIM by stakeholders, lack of knowledge about BIM software, lack of awareness of BIM benefits, lack of engineers' skills in BIM, lack of education and training on the use of BIM, lack of demand from clients, and lack of governmental regulations. It is recommended to conduct awareness program for stockholders regarding MIM benefits. Education and training for engineers at universities is strongly recommended so that they can apply BIM in the practice.**

**Keywords –**

**Construction; BIM; Challenges; Implementation; Performance**

## 1 Introduction

There are several problems when implementing BIM in the fragmented construction industry and which connected with many different barriers hindering effective adoption of BIM [1, 2]. Some of these barriers are quite simple to be removed, while others could be considered impossible to mitigate [3]. Yan and Damian [4] indicated, that the barriers to implement BIM in UK and USA are: people refuse to learn and think current design technology is enough for them to design the projects; people think that (BIM) is unsuitable for the projects; about (40%) of respondents from USA and about (20%) respondents from UK believe that BIM wastes time and human resources and their companies have to allocate lots of time and human resources to the training process; in addition to the cost of copyright and training.

Howard and Björk [5] found many obstacles to implement BIM in Denmark, Hong Kong, Holland, Norway, Sweden, UK and USA. The obstacles were: need of education; need of sharing information; lack of standards; and lack of legal issues to implement BIM. Arayici et al. [6] stated that the reasons to implement BIM in UK and Finland were: firms are not familiar enough with BIM use; reluctance to initiate new workflows, or train staff; firms do not have enough opportunity for BIM implementation; benefits from BIM implementation do not outweigh the costs to implement it; benefits are not tangible enough to warrant its use; and BIM does not offer enough of a financial gain to warrant its use.

Construction projects in Gaza strip suffer from many complex issues due to the fragmented nature of the construction industry and the lack of knowledge sharing as well as lack of communication between different professionals and stakeholders. In addition, the rising cost of construction projects remains the greatest problem the construction industry is facing now in Gaza Strip. Hence, the adoption of new and developing technology by construction firms would be pivotal in the overall development and success of the industry. The objective of this study is to identify and evaluate challenges that are facing the application of BIM in the Palestinian construction industry.

## 2 Literature review

Participants in the building process are constantly challenged to deliver successful projects despite tight budgets, limited manpower, accelerated schedules, and waste [7]. The Architecture, Engineering and Construction (AEC) industry has long sought to adopt techniques to decrease project cost, increase productivity and quality, reduce project delivery time,

and eliminate waste [8]. One of these techniques is Building Information Modeling (BIM). Azhar et al. [9] said that BIM has recently attained widespread attention in the AEC industry.

Keegan [10] identified several barriers to the utilization of BIM in USA, namely: lack of knowledge about BIM by the owner; lack of t knowledge about the software; and cost of implementing and updating the system. Becerik-Gerber et al. [11] reported two main groups of challenges to implement BIM: technology and process challenges; and organizational challenges. Lahdou and Zetterman [12] stated that the challenges for adoption of BIM in the construction project process in Sweden were: personal opinions towards BIM; difficulties in implementation of BIM software; and lack of knowledge.

Kjartansdóttir [12] reported that the reasons for not applying BIM in Iceland were: BIM is lacking features or flexibility to create building model/drawing; clients are not requiring BIM; BIM is too expensive; and the lack of training in BIM software. Khosrowshahi and Arayici [14] identified the most significant reasons to failure to implement BIM in the UK and Finland as: firms are not familiar enough with BIM use; reluctance to initiate new workflows or train staff; benefits from BIM implementation do not outweigh the costs to implement it; benefits of BIM are not tangible enough to warrant its use; lacks the capital to invest in having started with hardware and software; resistance to culture change; and no demand for BIM use. Kassem et al. [15] investigated the barriers to adopt BIM and 4D in the UK civil and building industry. They found that the most of the barriers were shortage of experience within the workforce; and lack of awareness by stakeholders.

Elmualim and Gilder [16] investigated the challenges that are facing the construction industry in the installation of BIM in the UK, Europe, USA, India, Ghana, China, Russia, South Africa, Australia, Canada, Malaysia and UAE. Findings from their study showed that: (20.4%) of the respondents stated that they lack the capital to invest in getting started with the hardware and software; about (2%) stated that BIM is too risky from a liability standpoint to warrant its use, (15.3%) stated that the benefits of BIM do not outweigh the cost to implement it; (15.3%) stated that the benefits are not tangible enough to warrant its use. Thurairajah and Goucher [17] mentioned several obstacles for implementing BIM: overall lack of knowledge and understanding of what BIM is; a strong training requirement associated with BIM implementation to gain the full advantages from it; and the need for detailed understanding of cost consultants' challenges during the implementation of 5D BIM in construction projects.

Crowley [18] revealed that the potential barriers to BIM implementation are: lack of training/ education; lack of client demand; lack of government lead/direction; and lack of standards. Aibinu and Venkatesh (28) reported the barriers to the adoption of BIM were: cost of implementation; lack of awareness of the benefits from cost benefit analysis perspective; lack of demand by clients; lack of trust in the integrity of BIM; and adaptation issues; and technology change and ability of firms to adapt to the change from cultural perspective and financial perspective.

Fischer and Kunz [19] reported two main groups of obstacles: technical obstacles; and managerial obstacles. Arayici et al. [20] said that the (BIM) barriers can be grouped into four categories: the legal issues; the cultural issues; the technological issues; and the fragmented nature of the construction industry industry. Becerik-Gerber et al. [11] reported two main groups of challenges to implement BIM: technology and process challenges; and organizational challenges. Both and Kindsvater [21] grouped BIM barriers into the following four categories: technological issues; normative issues; general issues; and education and training. Gu et al. [22] categorized barriers to adopt BIM in the AEC industry into three groups: product; process; and people.

## 3 Methodology

A quantitative survey approach involving professionals (Architects, Civil engineers, Mechanical engineers, Electrical engineers, and any other and any other related specialization) in the construction industry in Gaza strip, Palestine has been adopted. Convenience sample was chosen as the type of sample. A total of 275 copies of the questionnaire were distributed and 270 copies of the questionnaire were returned from the respondents with respondents' rate of 97.8 %. Personal delivery for the whole sample helped to increase the rate of response and thus the representation of the sample.

A total of 36 challenges to BIM utilization in the construction industry were assembled from extensive literature review which was further refined based on a pilot study. As a result of the pilot study, some items have been selected; other items have been modified, while others have been merged, as well as some items have been added. As a result 18 challenges were selected for this study. Analysis of the data was undertaken using IBM SPSS Statistics (Statistical Package for the Social Sciences) Version 22(IBM).

The relative importance index method (RII) was used to determine the ranks of BIM barriers as perceived by the respondents. Respondents were invited to rate their response on a five- point Likert Scale. The relative importance index was computed as [23, 24, 25]:

$RII = \Sigma W / (A * N)$

Where:

W = the weighting given to each factor by the respondents (ranging from 1 to 5)

A = the highest weight (i.e. 5 in this case)

N = the total number of respondents

The RII value had a range from 0 to 1 (0 not inclusive), the higher the value of RII, the more impact of the attribute. However, RII doesn't reflect the relationship between the various items.

## 4 Results and Discussion

Out of 36 challenges that were assembled from literature review, 18 potential challenges to BIM implementation were selected after modifications according to the pilot study. The descriptive statistics, i.e. means, standard deviations (SD), t-value (two-tailed), probabilities (P-value), relative importance indices (RII), and ranks were established and presented in Table (1). Items/Variables were categorized with ratings from 77.33 % to 66 % (Figure 1).

The findings indicated that "Lack of awareness of BIM by stakeholders" (BA 2) is the most influential barrier to adopt BIM in the construction industry in Gaza Strip. It has been ranked as the first position with (RII = 77.33%) and (P-value = 0.00*). This result indicates that a significant proportion of respondents have little or no understanding of BIM concept. This is consistent with the result which has been found by Kassem et al. [15]. Also, this result is in line with Thurairajah and Goucher [17] who found that, there is a lack of knowledge and understanding of BIM among professionals in the construction industry. According to the study of Löf and Kojadinovic [26] in Sweden, the reason for the lack of knowledge of BIM is the lack of guidelines on how to use and align BIM in the production phase of construction projects.

"Lack of knowledge of how to apply BIM software" (BA 3) (RII = 76.80 %; P-value = 0.00*) was ranked as the second BIM barrier for adopting BIM in the construction industry in Gaza Strip. Due to the complexity of gathering all the relevant information when working with BIM on a building project some companies have developed software designed specifically to work in a BIM framework. This result is consistent with Tse et al. [27] results, who found that a large part of the architects stated that BIM is "not easy to use". Also, this result is in line with which has been found in Sweden by Lahdou and Zetterman [11], who found that project managers in construction projects, claimed that the implementation of BIM is not always as easy as software developers suggest. A usual problem is getting different file formats to function properly when creating a combined building information model.

"Lack of awareness of the benefits that BIM can bring to engineering offices, companies and projects" (BA 5) was ranked in the third position with (RII of 76.22 %; P-value = 0.00*). There is a knowledge gap regarding BIM application in the Gaza Strip. The result is agreed with those reported about barriers for BIM adoption in the UK by Arayici et al. [6], and Kassem et al. [15]. Also, this outcome corroborates the findings of the studies of Khosrowshahi and Arayici [14], Aibinu and Venkatesh [28], and Elmualim and Gilder [16], whose research studies determined lack of awareness of BIM benefits as one of the main barriers associated with BIM implementation in the AEC industries in (UK and Finland), Australia, and (UK, Europe, USA, India, Ghana, China, Russia, South Africa, Australia, Canada, Malaysia and UAE), respectively. In addition, professionals in Australia displayed a degree of hesitancy in implementing BIM on a project because of the lack of knowledge about BIM and its distinctive capabilities in the field of construction industry [29]. In Hong Kong, Tse et al. [27] revealed that a large part of the architects did not find the tools in BIM to satisfy their needs. Thus, BIM benefits are still often misunderstood or not known to those not use it in their works [26].

"Necessary high costs to buy BIM software and costs of the necessary hardware updates" (BA 1) (BIM barrier) was ranked as the lowest barrier for BIM adoption in the 18th position with (RII = 66 %; P-value = 0.00*). This view has more than one interpretation, based on the point of view from some respondents; they do not really know how much costs need to adopt BIM. While there was another point of view from other respondents who are working in consulting offices, which is that the initial costs that must be spend in the beginning will not affect the organization for a long time as long as there are great benefits to be gained from BIM adoption in the long run. There are several examples of the high costs that are needed to implement BIM, such as: software licensing; the costs to improve server capacity to suit having such a high IT requirements; ongoing maintenance fee; the cost of the proper creation of a building model; and the costs of training.

Regarding results for all BIM barriers, the mean for all those items equals 3.59 and the total RII equals 71.80 %, which is greater than 60% (the neutral value of RII (3/5)*100 = 60%. The value of t test equals 14.54, which is greater than the critical value of t that equals 1.97. As well as, the total p-value of the all items equals 0.00 and it is less than the significance level of 0.05. Based on all previous results, BIM barriers are greatly affecting the adoption of BIM in the construction industry in the Gaza Strip.

Table (1): Challenges to BIM utilization

| No. | Challenges statements | Mean | SD | RII (%) | *t*-value (two-tailed) | *P*-value (Sig.) | Rank |
|---|---|---|---|---|---|---|---|
| BA 2 | Lack of awareness of BIM by stakeholders | 3.87 | 0.99 | 77.33 | 14.34 | 0.00* | 1 |
| BA 3 | Lack of knowledge of how to apply BIM software | 3.84 | 0.95 | 76.80 | 14.50 | 0.00* | 2 |
| BA 5 | Lack of awareness of the benefits that BIM can bring to engineering offices, companies and projects | 3.81 | 0.98 | 76.22 | 13.63 | 0.00* | 3 |
| BA 14 | Lack of interest in Gaza strip to pursue the condition of the building over the life after completion of implementation stage | 3.75 | 1.10 | 75.04 | 11.29 | 0.00* | 4 |
| BA 15 | Lack of architects/engineers skilled in the use of BIM programs | 3.71 | 1.11 | 74.15 | 10.47 | 0.00* | 5 |
| BA 16 | Lack of education or training on the use of BIM, whether in the university or any governmental or private training centers | 3.69 | 1.02 | 73.78 | 11.14 | 0.00* | 6 |
| BA 12 | Lack of demand and disinterest from clients regarding with using BIM technology in design and construction of the project | 3.69 | 1.11 | 73.78 | 10.22 | 0.00* | 7 |
| BA 11 | Lack of governmental regulations to fully support implementation of BIM | 3.68 | 1.14 | 73.68 | 9.82 | 0.00* | 8 |
| BA 4 | Professionals think that the current CAD system and other conventional programs satisfy the need of designing and performing the work and complete the project efficiently | 3.67 | 1.01 | 73.46 | 10.97 | 0.00* | 9 |
| BA 13 | Lack of real cases in Gaza strip or other nearby areas in the region that have been implemented by using BIM and have proved positive return of investment | 3.67 | 1.12 | 73.46 | 9.74 | 0.00* | 10 |
| BA 6 | Lack of effective collaboration among project stakeholders to exchange necessary information for BIM application, due to the fragmented nature of the AEC industry in Gaza strip | 3.57 | 0.98 | 71.41 | 9.57 | 0.00* | 11 |
| BA 18 | Reluctance to train architects/engineers due to costly training requirements in terms of time and money | 3.51 | 1.08 | 70.30 | 7.81 | 0.00* | 12 |
| BA 8 | Lack of the financial ability for the small firms to start a new workflow that is necessary for the adoption of BIM effectively | 3.42 | 1.17 | 68.43 | 5.90 | 0.00* | 13 |
| BA 9 | Companies prefer focusing on projects (under working/ construction) rather than considering, evaluating and implementing BIM | 3.40 | 1.07 | 67.93 | 6.08 | 0.00* | 14 |
| BA 10 | Difficulty of finding project stakeholders with the required competence to participate in BIM | 3.36 | 1.03 | 67.21 | 5.75 | 0.00* | 15 |
| BA 7 | Resistance by companies and institutions for any change can occur on the workflow system and refusal of adopting a new technology | 3.36 | 1.08 | 67.21 | 5.41 | 0.00* | 16 |
| BA 17 | Unwillingness of architects /engineers to learn new applications because of their educational culture and their bias toward programs that are familiar to them | 3.33 | 1.10 | 66.54 | 4.90 | 0.00* | 17 |

Table (1): Challenges to BIM utilization

| No. | Challenges statements | Mean | SD | RII (%) | *t*-value (two-tailed) | *P*-value (Sig.) | Rank |
|---|---|---|---|---|---|---|---|
| BA 1 | Necessary high costs to buy BIM software and costs of the necessary hardware updates | 3.30 | 1.12 | 66 | 4.41 | 0.00* | 18 |
| | All barriers | 3.59 | 0.67 | 71.80 | 14.54 | 0.00* | |

*Critical value of t*: at *degree of freedom (df)* = [*N-1*] = [270-1] = 269 and *significance (Probability) level* 0.05 equals "1.97"

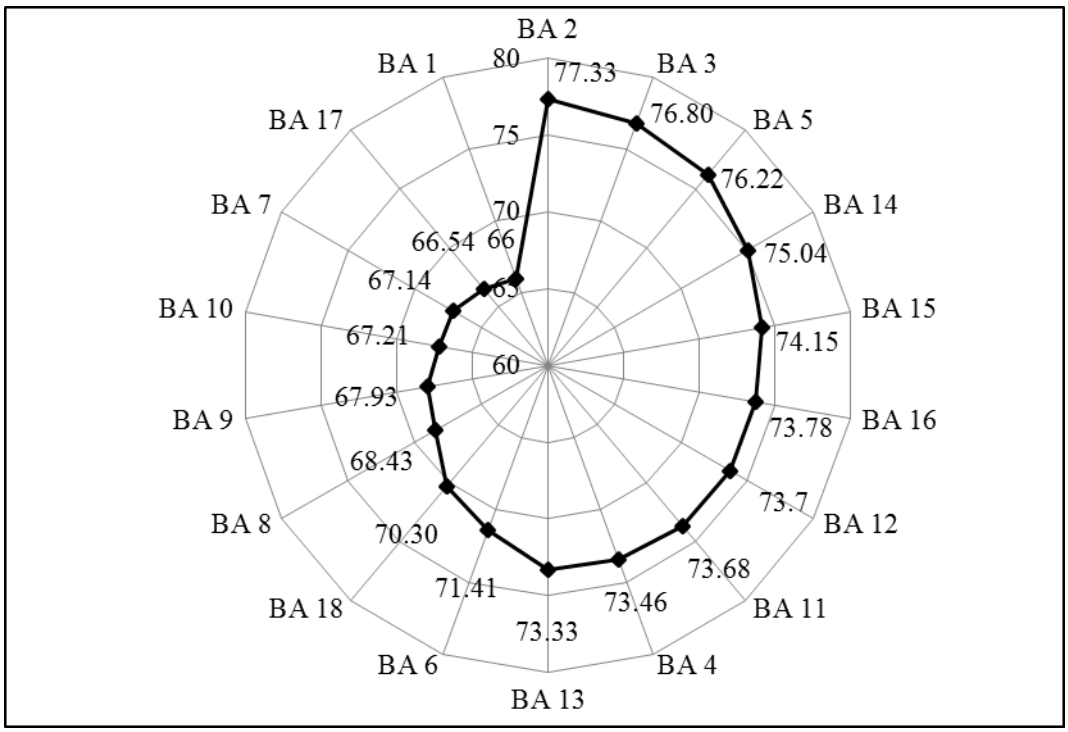


Figure (1): RII of BIM challenges (BA 1 to BA 18)

## 4 Conclusion

A research study has been carried out to identify and explore the challenges to BIM utilization in the construction industry. The results of this study revealed that the main challenges to the utilization of BIM were: lack of awareness of BIM by stakeholders, lack of knowledge about BIM software, lack of awareness of BIM benefits, lack of engineers' skills in BIM, lack of education and training on the use of BIM, lack of demand from clients, and lack of governmental regulations.

## 5 Recommendation

It is recommended to conduct awareness program for stockholders regarding the benefits from BIM utilization as BIM can reduce time, cost and enhance project quality. Education and training for engineers at universities is strongly recommended so that they can apply BIM in the practice. This study provides useful information for stockholders regarding challenges to BIM adoption so that they can overcome their obstacles. It is suggested to conduct further research in BIM

application and benefits by applying BIM in a real case study, so that the benefits can be clear to contract parties.

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