



Benefits and Barriers of BIM Adoption in the Iraqi Construction Firms

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Abstract: *The absence of using the advanced technology in the construction industry lead to conflicts and complexities in the implementation of project tasks in the various phases of construction. Therefore, the need to use the technique of Building Information modeling (BIM) is the essential matter to discover the conflicts that may occur during implementation the construction project. The purpose of this study is to identify the current perception to implement the BIM technique in the Iraqi construction firms. The method of data collection was a quantitative in nature, by designing a questionnaire to find out the perceptions of BIM benefits and barriers. Out of 180 emails, only 72 responses received which represented architects, civil engineers, MEP engineers, Owners, contractors, and consultants. Data analysis has been adopted the relative important index (RII) method, through a calculate the responses frequent by SPSS software, version 22. This study shows benefits and barriers of BIM technique in the Iraqi construction firms. In addition to that, offer solutions to overcome barriers.*

Key words; *advanced technology; Building Information modeling (BIM); BIM benefits and barriers; qualitative approach; construction companies in Iraq.*

I. INTRODUCTION

The construction industry in Iraq lacking to use the information communication technology (ICT) in construction [1]. The developing countries and Iraq are not excepted still using the traditional techniques such as 2D drawings in CAD software and using critical path method (CPM) in calculating time of project [2]. A collaborative approach cannot support by using the traditional approach in design and analysis of diagrams. All specialists, including Architects, civil engineers, and other stakeholders cannot produce the drawings with high quality because of the fragmentation of CAD documents and drawings. The drawings produced by the traditional methods are not integrated, therefore it causes clashes in the drawings and leads to increase in time and cost of the project. In addition to that, the engineers cannot estimate the cost of the project exactly because of the quantity take offs has been depending on the CAD documents. Traditional methods do not support integrated between schedules and drawings.

Currently, designers, engineers, and contractors are using of BIM tools in their projects (Luthra 2010). BIM adoption in the USA increased from 49% in 2009 to above 71% in 2012 McGraw-Hill Construction (2012). In contrast, the Iraqi construction firms are not using the true potential of BIM technique. Construction industry adopted the building information modeling (BIM) technique in the 1990s in some advanced countries such as USA, UK. In the beginning, there are some industries adopted the BIM technique in the market such as steel structure which employed the 3D model in the design. After the development that witnessed by the construction industry in the information technology became easily adoption BIM tools in all construction aspects. Therefore, this advance in using of BIM tools considered is a reward of construction industry's commitment to Building Information Modeling (BIM) over the last 20 years[3]. Building Information Modelling (BIM) is a three-dimensional digital representation of a building with its characteristics and components [3]. National Institute of Building Sciences (NIBS) in the USA defined BIM is a computable representation of all the physical and functional characteristics of a building and its related project/lifecycle and storing of information of the building to maintain and use over the life cycle of buildings [4].



Therefore, this study aims to investigate the current state to adopt of BIM technique in Iraq by exploring benefits and barriers, in addition, find out the future expected of BIM technique based on the results.

II. LITERATURE REVIEW

2.1 CONSTRUCTION INDUSTRY IN IRAQ

The security in the Iraq still not stable and play the most important role in the challenges faced the construction industry. In the latest report by BMI research stated that the growth in the construction industry will stay unchanged with little growth in 2016, and expectations of 3.3% after a few years of the economic downturn. While growth in the construction industry in the long term will reach 4.7% annually to 2025, this growth is much less than of Iraq potentials. In the beginning of 2016, the government of Iraq canceled the project with 9 billion USD in Baghdad and postponed more than 2000 projects because the fiscal crisis which faced the Iraqi government due to decrease sharply of oil prices, though, these projects has been approved by the Iraqi government in the budget of 2015. However, the oil price decreased in the last few years, which play a significant role in the construction industry, but the Iraqi government made much achievement against the Islamic State, this in turn will improve economy and increase the chance of investment in the construction sector.

INFRASTRUCTURE - CONSTRUCTION INDUSTRY FORECASTS (IRAQ 2016-2021)

	2016F	2017F	2018F	2019F	2020F	2021F
CONSTRUCTION INDUSTRY VALUE, IQDBN	21,143.36	24,037.21	26,585.16	29,634.48	32,956.50	36,594.90

2.2 BUILDING INFORMATION MODELING (BIM)

Building information Modelling (BIM) is innovative technique that assist on the improving of communication and collaboration among stakeholders involved in the construction project, thus BIM technique assist to achieve better quality for the final product of project [5]. BIM is one of the latest topics which deals with issues of construction in this days. The best define of BIM is sharing of digital information in the built environment. All stakeholders can be benefited from BIM technique by sharing information among them. BIM technology is a tool to solutions to most of the problems which faced by planners, designers, and other stakeholders in the construction projects. Due to the active role which plays this tool in terms of improving the collaboration and communication among the stakeholders in the project, therefore has the ability to enhance the performance of construction projects. In fact, the term has not gained general definition and in many professional organizations may vary. Building Smart proposed a definition of BIM for the UK construction industry: "Building Information Modelling is a digital representation of physical and functional characteristics of a facility creating a shared knowledge resource for information about it forming a reliable basis for decisions during its life cycle, from earliest conception to demolition. BIM technique can be used in all project phases as can be seen in figure 1. In the planning and scheduling stage, project managers and planners benefited from the BIM application such as 4D in calculating project schedule. While, in the design phase, designers benefit from BIM application in improving visualization and analysis of the building, and so on.

BIM is as a computer-aided modeling technology in order to manage the information through working in the construction project [6]. In a recent survey conducted by [7] showed that, 46% of construction professionals are using of BIM technique in more than 30% of their projects and considered this percentage is very heavy users to use BIM technique. In addition many studies which identified rate of adoption BIM in construction industry such as McGraw-Hill Construction's [8]. Relationships among the stakeholders in the BIM model can be represented in the figure (2). BIM technique enable stakeholders to work on the same mode in the same time. This technique increase collaboration and communication among all stakeholders involved in construction project.

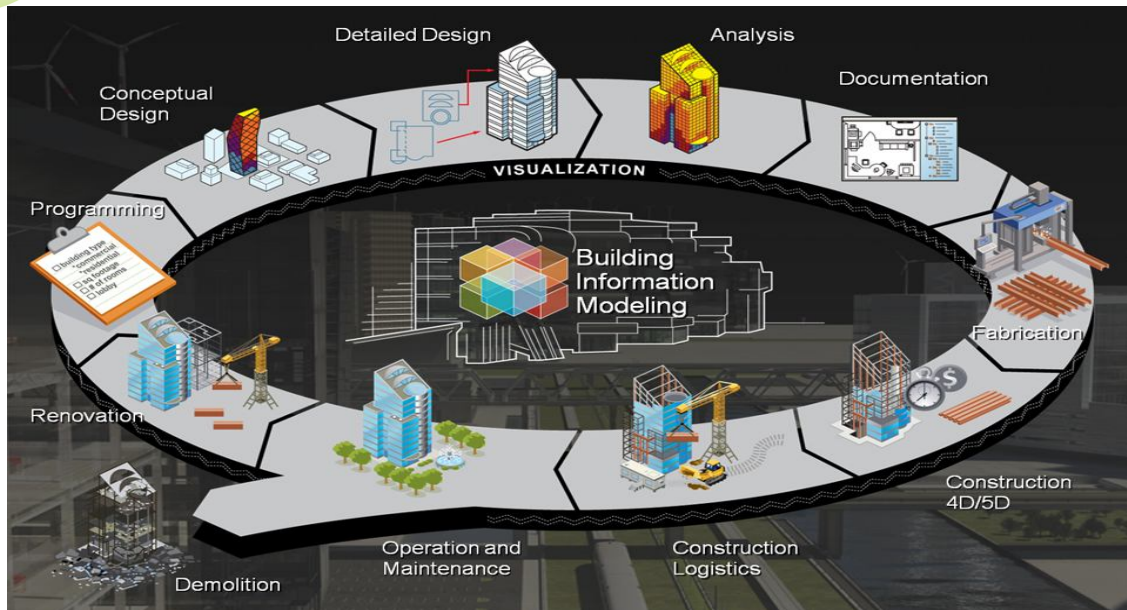


Figure 1: Using of BIM in project phases



Figure 2 Relationships between the BIM project and stakeholders in project

2.3 BENEFITS OF BIM TECHNIQUE:

There are many of benefits resulting on implement BIM technique in the construction projects can be summarized in table 1. These benefits assist all stakeholders in the construction projects to improve the communication and collaboration among professionals in the construction project. In latest study by [9] find out the benefit and challenges to adopt BIM in construction industry, he found that the benefits of adopting BIM can be summarized as saving the cost of projects, minimizing the time needed to project delivery, improve safety factor in the construction project, Client satisfaction, Planning efficiency to the construction projects, rework efficiency, and others benefits. While [10] in 2010, identify the BIM benefit as improving visualization, clash detection in the designs, building assembly, and others. BIM technique assists the project manager and others stakeholders interested to control the variables in the project such as, minimizing time to accomplish of project, saving cost as possible, improving quality of project in the early stage oh construction project [11, 12].



Thus, the benefits mentioned above will increase the production efficiency and improve the final product [13, 14]. Benefits of BIM technique are due to the availability of information and the true management of information [15, 16]. The advantages of BIM differ from industry to other and from company to company, but all the advantages result to the cost and time needed to achieve the projects, in addition to improve the quality of product.

TABLE 1: BENEFITS OF BIM TECHNIQUE

NO	BENEFITS OF ADOPT BIM TECHNIQUE	REFERENCE
P1	ABILITY TO BUY NEW HARDWARE AND SOFTWARE TO BIM	[17-23]
P2	ABILITY TO TRAIN COMPANY STAFF ON THE BIM SOFTWARE	[17, 18, 20, 22]
P3	ENCOURAGE TO IMPLEMENT BIM BY GOVERNMENT	[17, 18, 21, 24]
P4	FREE COURSES TO PEOPLE WHO USE BIM TECHNIQUE	[17, 19]
P5	MINIMIZING FROM COST OF PROJECT	[17, 19, 23, 25-27]
P6	MINIMIZING OF TIME NEEDED TO COMPLETE PROJECT	[17, 19, 23, 25-27]
P7	CLIENT DEMAND	[17, 20, 23]
P8	PROVEN SUCCESSFUL ON THE RESEARCH PROJECTS	[17, 18, 28]
P9	UNDERSTANDING AND AWARENESS TO BIM TECHNIQUE	[17, 26, 28]
P10	SUPPORT FROM PROFESSIONAL BODIES	[17, 22, 28]
P11	REDUCE SAFETY RISKS IN THE DESIGN PHASE	[21, 26-28]
P12	PREDICTABILITY OF PROJECT TIME	[19, 25, 28]
P13	IMPROVE VISUALIZATION	[17, 26, 27, 29]
P14	IMPROVE COLLABORATION	[3, 25-27, 30]
P15	IMPROVE COMMUNICATION	[18, 26, 27, 30]
P16	CLASH DETECTION	[3, 18, 26, 31]
P17	MINIMIZING REWORK	[3, 26, 27, 32]
P18	MAXIMIZING PRODUCTIVITY	[3, 25, 27, 32]
P19	REDUCE MISSING DATA	[3, 26, 33]
P20	IMPROVED DOCUMENT MANAGEMENT AND INTEGRATION	[3, 26, 27, 33]

2.4 BARRIERS TO ADOPT BIM TECHNIQUE:

Regarding barriers and challenges which reduce to adopt BIM technique in the construction industry, there are many studies identified the barriers, can be illustrated in table 2. Construction Management Association of America (CMAA) conducted a survey include owners in 2007, showed that 35% of surveyed indicated of owners that implemented of BIM technique at least one time or more, in addition to 12% of them had used it at least to five years. In the same time, the result of this survey indicated that lack of expertise between the stakeholders involved in the projects was the greatest obstacle to adopting of BIM technique within the construction industry[34]. the teaching of BIM technique is expected to be the solution of more problems that related of the BIM learning curve to adopt BIM, therefore the construction companies may employ people who have graduated from universities [8].

TABLE 2: BARRIERS OF BIM TECHNIQUE

NO	BARRIERS TO ADOPT BIM TECHNIQUE	REFERENCE
1	LEGAL ISSUE	[5, 18, 31, 35, 36]
2	HIGH COST OF BIM SOFTWARE AND HARDWARE	[5, 6, 9, 18, 31, 34-41]
3	HIGH COST OF TRAINING ON THE BIM TOOLS	[5, 9, 18, 31, 35-37, 42]
4	LACK OF SKILLED PERSONNEL	[5, 9, 18, 31, 34, 35, 39, 41]
5	LACK OF SKILLS AND KNOWLEDGE FOR COMPANY STAFF	[5, 8, 9, 18, 31, 42]
6	RESISTANCE TO CHANGE	[5, 9, 18, 31, 35]
7	LACK OF DEMAND FROM OWNER	[5, 18, 31, 35]
8	LACK OF AWARENESS ABOUT BIM BENEFITS.	[9, 18, 31]
9	BENEFITS OF BIM NOT TANGIBLE.	[18, 31, 35]
10	LACK OF EXPERTISE	[5, 9, 18, 31]
11	SHORTAGE OF BIM APPLICATIONS CURRENTLY	[5, 9, 13, 18, 34, 41]
12	LACK OF SUPPORT FROM GOVERNMENTS	[18, 31]

III. METHODOLOGY

A literature review has been conducted to find out the knowledge gap related benefits and barriers of BIM technique in the Iraqi construction firms. A questionnaire survey has been designed to meet of research objectives, which consist of three parts. The first part was profile of respondents, the second part was benefits of BIM to construction companies and the third part about barriers and challenges of BIM technique. Out of origin 180 participant, only 72 respondents completed the form of survey and received to the researcher, which constituted 40% only. The result of questionnaire survey can be considered an important if the responses rate not less than 30% [43]. The respondents was represented most stakeholders in the construction projects, such as architectures, civil engineers, MEP engineers, Owners and contractors. The questionnaire survey aim to find out the benefits and barriers which effecting on the adoption of BIM in the Iraqi construction firms. The factors determined before from literature review and put it in two categories, benefits, and barriers [3]. Barriers and benefits of using BIM technique, put in two tables in the questionnaire to evaluate important it by the participants on a five-point Likert scale. Data analysis conducted by adopting the relative important index RII to find out the importance of factors which represented the benefits and barriers to implementing BIM technique in the construction projects. The factors put in rank, the top ranked is more important than the next and so on [44].

The RII value calculated as below:

$$\text{Relative importance index (RII)} = \frac{\sum w}{(A \times N)} \dots, (0 \leq \text{RII} \leq 1)$$

Whereas: w = weighting given to each factor by the respondents which limited from 1 to 5

Where 1 is very unimportant, 2 is not important, 3 is neutral, 4 is important and 5 is very important.

A = highest weight = 5, and N = total number of respondents = 72).

IV. SAMPLING

The sample for this study consist of architects, civil engineers, MEP engineers, consultants and contractors. Out of 180 questionnaire sent out to respondents, only 72 completed and received to the researcher. The profile of respondents as shown in table 1. Respondents for this study have a good range in terms of variety in age and gender. Regarding gender, the percentage of a male was 70.8% and a female was 29.2%. In terms of age, the largest percentage of respondents were from category (31-40) year, which constituted 33.3%, and the lowest percentage of respondents were from category (20-30) years, which constituted only 16.7%. All the respondents have a good level of knowledge, they have graduated at least Bachelor's degree which reached 86.1%, while, master degree was 11.1%, and Ph.D. was 2.8%. Most of the respondents were site engineers and designers which constituted 30.6% and 22.2% respectively. Civil engineers were the largest percentage of respondents in terms of specialists, which constituted 58.3%. Experience in the construction industry for respondents varied from category (1-10) year which was 44.4% to category (more than 30) year which was 4.2% as can be seen in table 3 below.

TABLE 3: PROFILE OF RESPONDENTS WHO PARTICIPATED IN THE QUESTIONNAIRE

RESPONDENT INFORMATION	CATEGORIES	FREQUENCY	PERCENTAGE
GENDER	MALE	51	70.8%
	FEMALE	21	29.2%
AGE	20-30	12	16.7%
	31-40	24	33.3%
	41-50	20	27.8%
	MORE THAN 50	16	22.2%
EDUCATIONAL LEVEL	BACHELOR'S DEGREE	62	86.1%
	MASTER'S DEGREE	8	11.1%
	PH.D. DEGREE	2	2.8%
JOB TITLE	CONSULTATIVE	5	6.9%
	DESIGNER	16	22.2%
	SUPERVISOR	13	18.1%
	PROJECT MANAGER	10	13.9%
	SITE ENGINEER	22	30.6%
	CONTRACTOR	6	8.3%

SPECIALIST	ARCHITECT	21	29.2%
	CIVIL ENGINEER	42	58.3%
	MEP ENGINEER	9	12.5%
EXPERIENCE IN CONSTRUCTION INDUSTRY	1-10 YEAR	32	44.4%
	11-20 YEAR	23	31.9%
	21-30 YEAR	14	19.4%
	MORE THAN 30 YEAR	3	4.2%

V. RESULTS AND DISCUSSION

5.1 MOTIVATIONS AND BENEFITS TO ADOPT BIM TECHNIQUE IN THE IRAQI CONSTRUCTION INDUSTRY

From the benefits and motivations which have been determined from previous studies, minimizing the cost of the project (RII 0.94) that reached the largest significant of factors affected on adoption of BIM in Iraqi construction industry. Free courses to people who use BIM technique with (RII 0.908), and clash detection with (RII 0.905), while, encourage to implement BIM by the government was (RII 0.903) and demand by Client with (RII 0.897). The least significant factors of BIM adoption in the Iraqi Construction firms were proven successful in the research projects and ability to buy new hardware and software to BIM which constituted (RII 0.778 and RII 0.770) respectively. All motivations and benefits that affected on the importance of adoption BIM technique can be seen in table 2 below. This means that the respondents concentrated on the factor of minimizing the cost of the project and providing the free courses for companies' staff which implement the construction by using BIM technique in their projects.

TABLE 2 RESPONDENTS' VIEW ON BENEFITS OF ADOPTING BIM IN IRAQI CONSTRUCTION INDUSTRY.

No	MOTIVATION AND BENEFIT TO ADOPT BIM TECHNIQUE	MEAN	STD. DEVIATION	RII	RANK
P1	ABILITY TO BUY NEW HARDWARE AND SOFTWARE TO BIM	3.85	1.002	0.77	19
P2	ABILITY TO TRAIN COMPANY STAFF ON THE BIM SOFTWARE	4.18	.811	0.836	13
P3	ENCOURAGE TO IMPLEMENT BIM BY GOVERNMENT	4.51	.581	0.903	4
P4	FREE COURSES TO PEOPLE WHO USE BIM TECHNIQUE	4.54	.580	0.908	2
P5	MINIMIZING FROM COST OF PROJECT	4.71	.458	0.94	1
P6	MINIMIZING OF TIME NEEDED TO COMPLETE PROJECT	4.39	.571	0.878	7
P7	CLIENT DEMAND	4.49	.581	0.897	5
P8	PROVEN SUCCESSFUL ON THE RESEARCH PROJECTS	4.06	.820	0.778	18
P9	UNDERSTANDING AND AWARENESS TO BIM TECHNIQUE	4.31	.705	0.861	9
P10	SUPPORT FROM PROFESSIONAL BODIES	4.42	.666	0.883	6
P11	REDUCE SAFETY RISKS IN THE DESIGN PHASE	4.32	.601	0.864	8
P12	PREDICTABILITY OF PROJECT TIME	4.14	.861	0.828	14
P13	IMPROVE VISUALIZATION	4.06	.710	0.811	16
P14	IMPROVE COLLABORATION	3.97	.691	0.794	17
P15	IMPROVE COMMUNICATION	4.19	.705	0.838	12
P16	CLASH DETECTION	4.53	.530	0.905	3
P17	MINIMIZING REWORK	3.97	.787	0.794	17
P18	MAXIMIZING PRODUCTIVITY	4.29	.659	0.858	10
P19	REDUCE MISSING DATA	4.21	.670	0.842	11
P20	IMPROVED DOCUMENT MANAGEMENT AND INTEGRATION	4.11	.779	0.822	15

5.2 BARRIERS TO ADOPT OF BIM IN THE IRAQI CONSTRUCTION INDUSTRY

Table 3 illustrates the respondents' view on the barriers to adopting of BIM technique in the Iraqi construction firms, with the lack of skilled personnel which constituted the largest value (RII 0.92). The second factor which came in terms of rank was Lack of support from governments with (RII 0.905). While the high cost of BIM software and hardware having the third highest rank of the significant barrier in this study, followed by Lack of Expertise and Lack of awareness about BIM benefits with the relative importance of (RII 0.89) and (RII 0.869) respectively. The high cost of training on the BIM tools was ranked sixth with a relative importance index of (0.853).



Another important issue is the security situation in Iraq since the eighties last century until now not stable. Therefore, the construction firms in Iraq struggled in order to implement of BIM technique in their projects.

TABLE 3: RESPONDENTS' VIEW ON CHALLENGES OF ADOPTING BIM IN IRAQI CONSTRUCTION INDUSTRY.

NO	BARRIERS TO ADOPT BIM TECHNIQUE	MEAN	STD. DEVIATION	RII	RANK
Q1	LEGAL ISSUE	4.00	.919	0.8	9
Q2	HIGH COST OF BIM SOFTWARE AND HARDWARE	4.49	.628	0.897	3
Q3	HIGH COST OF TRAINING ON THE BIM TOOLS	4.26	.605	0.853	6
Q4	LACK OF SKILLED PERSONNEL	4.61	.545	0.92	1
Q5	LACK OF SKILLS AND KNOWLEDGE FOR COMPANY STAFF	4.19	.664	0.838	8
Q6	RESISTANCE TO CHANGE	3.96	.759	0.792	11
Q7	LACK OF DEMAND FROM OWNER	4.22	.697	0.84	7
Q8	LACK OF AWARENESS ABOUT BIM BENEFITS.	4.35	.715	0.869	5
Q9	BENEFITS OF BIM NOT TANGIBLE.	3.99	.741	0.797	10
Q10	LACK OF EXPERTISE	4.44	.579	0.89	4
Q11	WORKFLOW CONTROL	4.22	.697	0.84	7
Q12	LACK OF SUPPORT FROM GOVERNMENTS	4.53	.604	0.905	2

VI. CONCLUSION AND RECOMMENDATIONS

The study evaluated the state of BIM technique in the Iraqi construction firms through conducting a questionnaire survey to show the barriers and benefits of BIM. The results refer to that minimizing of the cost of project occupied the first rank of BIM benefits in the construction projects with (RII 0.94). The second factor important was free courses to people who use BIM technique with (RII 0.908) while, the lower rank in level of importance was ability to buy new hardware and software to BIM, with (RII 0.77). On the other hand, barriers and challenges, lack of skilled personnel occupied the first rank by respondents with (RII 0.92). Lack of support from governments came in the second rank, with (RII 0.905), and high cost of BIM software and hardware came in the third rank, with (RII 0.897) that agree with study conducted by [31] about barriers that prevent adoption of BIM in Iran, whereas, the factor of, cost of BIM software, came in the third rank also. The study conducted to be a base and foundation for more research and development regarding adoption of BIM technique in Iraqi construction firms. Besides, contributed in providing a further information about barriers and benefits toward adoption of BIM in Iraqi construction firms. The study recommends that government of Iraq and their agencies associated with it should play a significant role in the adoption of BIM technique by encouraging the construction firms and professionals interested in the construction industry to adopt BIM.

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