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Analysis of the Benefits for Adopting Building Information Modelling (BIM) in Iraq

[1]Wadhah A. Hatem, [2]Abbas M. Abd and [3]Nagham N. Abbas
[1]Baquba Technical Institute, College of Engineering, Middle Technical University, Baqubah, Iraq
[2]Department of Architecture,
[3]Department of Civil Engineering, College of Engineering, University of Diyala, Baqubah, Iraq

Abstract: Building Information Modeling (BIM) is a unified and comprehensive system for all what is associated with the construction project which includes a set of effective policies, procedures and computer applications that increase the level of performance in construction project during its life cycle. This study investigated the potential benefits of using BIM in Iraq. The quantitative approach was adopted by conducting a questionnaire directed to professionals in the field of construction projects in the public and private sectors. (300 copies) were distributed to the private companies and governmental institutions and departments. The data were subjected to the appropriate statistical analysis and the results showed that the three highest potential benefits of using BIM in Iraq showed saving on the cost of the project, providing high quality and fast data documentation system was minimizing change orders.

Key words: Benefits, BIM, building information modeling, Iraq, providing high quality, documentation

INTRODUCTION

The construction industry is witnessing a paradigm shift that will achieve the highest productivity, efficiency, quality, sustainability and the value of infrastructure and reduce the costs of the life cycle as well reduce time (Arayici *et al*., 2009). This is consistent with what (Azhar *et al*., 2008) said about construction industry tends to adopt techniques that reduce the cost of the project, increase the productivity and quality of the project and reduce the project time.

One of these techniques is Building Information Modeling (BIM) which is a technological and procedural shift in the construction industry (Succar, 2009).

Building Information Modeling (BIM) is an advanced tool and process consisting of a combination of virtual features, systems and concepts facilitated within a unified environment (Azhar *et al*., 2015). It includes the application and keeps integrated digital representation for different information across different project stages (Eastman *et al*., 2011).

One of main benefits of BIM is the accurate geometrical representation for building parts within an integrated information environment (RCCI., 2007). The BIM as a new phenomenon seeks to renew the practices of the construction industry, so, it is subject to challenges facing its application (Kekana *et al*., 2014).

For the implementation of BIM, this requires good planning and a coordinated approach with considerations for implementation and innovation management (Smith and Tardif, 2009).

The urgent need for the reconstruction of Iraq after the wars and the conditions that that accompanied with it made the construction industry the most important among the industries, however, it suffers from a series of complex problems that make the progress of projects difficult either in new projects or in the rehabilitation of existing projects. The fragment nature of the research and its negative impact on the project, the weakness in communication and information sharing among different stakeholders, the high cost of projects which is one of the biggest problems, the delays in projects and exceeding the prescribed period and in addition to other problems.

On the contrary, BIM has recently expanded and is able to solve most of the problems of the construction projects and despite the benefits they are not implemented in Iraq as in other countries of the world. Therefore, building a clear understanding of the concept of BIM by investigating the benefits it offers to the projects is important to promote the adoption of BIM in the construction projects of Iraq. Table 1 provide a summary of top BIM benefits according to several previous researchers.

Corresponding Author: Wadhah A. Hatem, Baquba Technical Institute, College of Engineering, Middle Technical University, Baqubah, Iraq

Table 1: Top BIM benefits according to previous researchers

UK (Porwal and Hewage, 2013)	Countries from europe (Bryde *et al*., 2013)	China (Li *et al*., 2014)
Limiting incidents and improving site safety	Saving on the cost of the project	Ability to simulate design model
Reduce change orders	Reduce the time of the project	Better modeling for complex buildings
	Facilitating the construction industry based on prefabricated building components	Reduce design errors and rework
		Saving on the cost of the project
	Building maintenance management	Reduce the time of the project
New Zealand (Stanley and Thurnell, 2014)	**Ghana (Armah, 2015)**	**Palestine (Abuhamra, 2015)**
Calculate estimates directly from the model	Constructability improvement	Provide cooperation between project stakeholders
The ability to visualize the building	The ability to visualize the building	Improve quality of design
Minimize rework	Improve productivity	Improving in sustainable design
	Detection of clashes	Study alternatives and support the decision-making process
	Improve the quality of the project	
		The ability to visualize the building
Italy (Ciribini *et al*., 2016)	**China (Doumbouya *et al*., 2016)**	**Sudan (Osman, 2016)**
Saving on the cost of the project	Provide cooperation between project stakeholders	Saving on the cost of the project
Reduce the time of the project	Decision-making support	Detection of clashes
Ability to simulate design model	Coordination in the project management	Speed up design processes
	Reduce risks	Optimization of construction processes
Brazil (Haraguchi, 2016)	**Indonesia (Chandra *et al*., 2017)**	**Countries from middle East (Gerges *et al*., 2017)**
Ability to simulate design and construction digitally	Saving on the cost of the project	Coordination and detection of clashes
	Enhance customer satisfaction	Collaboration among stakeholders
Project data are available to all stakeholders	Improving the business opportunities	Calculate estimates directly from the model
Provide cooperation between project stakeholders	Reduce the time of the project	Visualize and manage the sequence of activities through 4D dimension
	Coordination in the management of project	
Reduce the time of the project		
Saving on the cost of the project		
China and UK (Zhou *et al*., 2017)	**India (NIBT., 2017)**	**UK (NBIMI., 2017)**
Reduced cost	Clients will increasingly insist on BIM adoption	Reduction in initial cost
quality improvement	New collaborative way of working and sharing of information	Reduction in the overall time
Reduced project duration		Reduction in greenhouse gas emissions
Improved safety	Reduction in costs and errors	

MATERIALS AND METHODS

This study investigates the benefits of BIM application in Iraq. The data were collected by using field survey through design a special questionnaire for this targeted delivery it to the professionals working in the construction project field. Respondents illuminated their views in a set of points in the questionnaire where 300 copies of questionnaires were distributed but the total return was only 273 copies with a response rate 87.7% with 11 incompletes copies, so, the final number of copies is 262. The questionnaire built-in two main parts.

Part 1; Respondent information: This part comprises general information concerning the respondent.

Part 2 ; BIM protentional benefits: This part included a list of the benefits of BIM. This part contains 24 closed questions designed by the 5-Likert scale (Likert, 1932). The scale is (Extremely high benefit, high benefit, moderate benefit, low benefits, extremely low benefit). Each respondent was invited to give a degree of measure to each question according to what he/she believes within the environment of the Iraqi construction sector.

After the collection of the questionnaires, they were arranged, unloaded and analyzed using the Statistical Packaging for Social Science (SPSS) Software Version 24.

Statistical analysis: A set of quantitative statistical techniques have been used to analyze the questionnaire data to obtain a comprehensive view of the opinions obtained from the specialists in Iraqi Architectural Engineering Construction (AEC) regarding the subject of BIM potential benefits. These statistical techniques will be clarified.

Descriptive statistics: Descriptive statistics can be defined as statistical methods aimed at summarizing data organizing data and simplifying data (Gravetter and Wallnau, 2016). Descriptive statistics that have been used are central tendency measurement and variability measurement.

Relative Importance Index (RII): One of the techniques used in the analysis of data is the Relative Importance Index RII and the purpose of its use is to give a rank for each item in a particular part in the questionnaire. The equations:

$$RII = \frac{\sum W}{(A \times N)} \quad (1)$$

$$RII = \frac{5(n_5)+4(n_4)+3(n_3)+2(n_2)+n_1}{5(n_5+n_4+n_3+n_2+n_1)} \quad (2)$$

Where:

W = The weight given by respondents for each component (ranging from 1-5)
A = The highest weight (which equals 5)
N = The total number of respondents

RESULTS AND DISCUSSION

General information for respondents: The demographic characteristics of target respondents shown in Table 2.

RII For BIM potential benefits: A value of RII for each item was calculated to obtain the rank of the single item within the rest of the items.

Table 3 shows the mean and standard deviation values for items and the resulting final ranks for each item. The results showed that "Saving on the cost of the project" is the highest potential benefit from BIM application according to the point of view of specialists with (RII = 87.863, mean = 1.61, SD = 0.777). This result is consistent with the Iraqi construction projects suffer from cost overruns due to several factors (Al-Ageeli and Alzobaee, 2016) who mentioned these factors.

The potential BIM benefit which was in the second rank is "Provide high-quality and fast data documentation system" with RII = 87.023, mean = 1.67, SD = 0.786. This result can be considered acceptable according to the exposure of many projects after the war and security conditions to the loss of partial or complete documentation of the project in addition to the existence of problems related to the documentation system itself and on the other hand this result agree with (Abdul-Kareem, 2017) who recommended by the need to exist and apply Information Technology IT in the field of documentation in Iraqi construction projects to overcome these problems.

Table 2: The respondent's profile

Information about categories	Percentage
Work sector	
Public sector	79
Private sector	14
Public and private together	7
Gender	
Male	69
Female	31
Age (years)	
20-30	25
31-40	51
41-50	18
More than 51	6
Academic qualification	
Diploma	3
Bachelor	80
Master	10
PhD	10.6
Other	1
Specialization	
Architect	4
Civil Engineering	52
Electrical Engineering	24
Mechanical Engineering	12
Other	8
Group (Job)	
Designer	14
Consultant	9
Project Manager	10
Site Engineer	50
Contractor	12
Other	5
Practical experience (years)	
<5	30
5-10	24
11-15	17
16-20	17
More than 20	12

Table 3: Rank of BIM potential benefits depending on RII, Mean, SD

No.	BIM potential benefits	Mean	SD	RII	Rank
B1	The ability to visualize the building with different details from different angles and better representation for complex buildings details	1.82	0.889	83.969	9
B2	Increased design efficiency by the ability to simulate the design model	1.85	0.866	83.130	10
B3	Digital virtual construction enables rapid analysis of various performance scenarios related building	1.96	0.888	81.450	14
B4	Link cost, time and other variables to the unified design model	1.74	0.848	85.344	6
B5	Facilitate cooperation between the different stockholder of the project such as the owner, designer, contractor and others to expand the area of interest in several aspects	1.73	0.860	85.725	5
B6	Improving the productivity of estimating the quantities of the project	1.77	0.817	84.733	7
B7	Support decision-making by providing a reliable database for all parts of the project	1.9	0.878	82.137	11
B8	Saving on the cost of the project	1.61	0.777	87.863	1
B9	The high flexibility offered by the BIM design, so that, the change in a particular location of the design followed by automatic change in all variables associated with it	1.97	0.918	80.687	17
B10	Detection of design errors and conflicts between different disciplines at early time and minimizing rework	1.7	0.822	85.954	4
B11	Enhance customer satisfaction	2.16	0.974	76.947	23
B12	Analysis of the building in terms of energy	2.12	1.001	77.634	22
B13	visualize the scheduling of the project this has a role in facilitating the coordination project processes and steps to reach an expected result	1.79	0.783	84.427	8
B14	Provide high-quality and fast data documentation system	1.67	0.786	87.023	2
B15	Minimize construction waste and manage it well	2.00	0.920	80.763	16
B16	Develop risk management and minimize risks as well as site safety planning and reduce accidents	2.10	0.991	77.934	21
B17	Improved construction communication management	2.17	0.947	76.718	24

Table 3: Continue

No.	BIM potential benefits	Mean	SD	RII	Rank
B18	Increase the delivery speed and finish of the project	1.92	0.925	82.061	12
B19	Easy and quick access to any details or sections of the building	2.00	1.041	79.924	18
B20	Increase productivity and quality of the project	1.93	0.914	81.832	13
B21	Minimize change orders	1.69	0.825	86.107	3
B22	Increased efficiency of procurement by processing accurate quantitative data as well as identify the plan and times of purchase	1.93	0.871	81.374	15
B23	Better maintenance management and technical accessories during the life of the building	2.06	0.929	78.779	20
B24	Enhanced location logistics plans and better site equipment management	2.03	0.960	79.313	19

The third potential benefit of BIM is "Minimize change orders" with RII = 86.107, mean = 1.69, SD = 0.825 that change orders have a role in increasing the cost and time of the project. This result is in line with (Nazar, 2014) findings of the benefits of BIM.

CONCLUSION

According to Iraqi professionals views the first benefits of using of BIM in Iraqi construction projects are saving on the cost of the project, providing high quality and fast data documentation system was minimizing change orders.

RECOMMENDATIONS

In order to increase the level of knowledge in BIM, it is recommended that many seminars and conferences be held which in consultation with the experts in the field of construction projects on the other hand to raise the skill level of engineers it is recommended to provide training programs in government centers and institutions. Building and supporting academic projects as well as encouraging researchers in the field of BIM which will facilitate the transfer of expertise and information from the world. The government must play a vital role by providing the main guidelines to institutions in its transition toward BIM.

REFRENCES

Abdul-Kareem, H.I., 2017. Investigation problems of documentation, updating information and following up construction project in Iraq. J. Eng. Sustainable Dev., 21: 193-204.

Abuhamra, L.A., 2015. An investigation into Building Information Modeling (BIM) application in Architecture, Engineering and Construction (AEC) industry in Gaza strip. Master Thesis, Islamic University of Gaza (IUG), Gaza City.

Al-Ageeli, H.K. and A.S.J.A. Alzobaee, 2016. The most influential factor on the stumble and failure of the governmental projects. J. Eng., 22: 93-110.

Arayici, Y., F. Khosrowshahi, A.M. Ponting and S.A. Mihindu, 2009. Towards implementation of building information modelling in the construction industry. Proceedings of the 5th International Conference on Construction in the 21st Century (CITC-V) Collaboration and Integration in Engineering, Management and Technology, May 20-22, 2009, University of Salford, Istanbul, Turkey, pp: 29-34.

Armah, N.N.O., 2015. Assessing the benefits and barries of the use of Building Information Modeling (BIM) in the Ghanaian building construction industry. Master Thesis, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Azhar, S., A. Nadeem, Y.N.K. Mok and H.Y.B. Leung, 2008. Building Information Modeling (BIM): A new paradigm for visual interactive modeling and simulation for construction projects. Proceedings of the 1st International conference on Construction in Developing Countries, August 4-5, 2008, Karachi, Pakistan, pp: 435-446.

Azhar, S., M. Khalfan and T. Maqsood, 2015. Building Information Modelling (BIM): Now and beyond. Constr. Econ. Build., 12: 15-28.

Bryde, D., M. Broquetas and J.M. Volm, 2013. The project benefits of Building Information Modelling (BIM). Int. J. Project Manage., 31: 971-980.

CRCCI., 2007. Adopting BIM for facilities management: Solutions for managing the Sydney opera house. Cooperative Research Center for Construction Innovation, Brisbane, Australia.

Chandra, H.P., P. Nugraha and E.S. Putra, 2017. Building information modeling in the architecture-engineering construction project in Surabaya. Procedia Eng., 171: 348-353.

Ciribini, A.L.C., S.M. Ventura and M. Paneroni, 2016. Implementation of an interoperable process to optimise design and construction phases of a residential building: A BIM pilot project. Autom. Constr., 71: 62-73.

Doumbouya, L., G. Gao and C. Guan, 2016. Adoption of the Building Information Modeling (BIM) for construction project effectiveness: The review of BIM benefits. Am. J. Civ. Eng. Archit., 4: 74-79.

Eastman, C., P. Teicholz, R. Sacks and K. Liston, 2011. BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. 2nd Edn., Johan Wiley & Son, Hoboken, New Jersey, ISBN:978-0-470-54137-1, Pages: 304.

Gerges, M., S. Austin, M. Mayouf, O. Ahiakwo and M. Jaeger *et al*., 2017. An investigation into the implementation of building information modeling in the middle East. J. Inf. Technol. Constr., 22: 1-15.

Gravetter, F.J. and L.B. Wallnau, 2016. Statistics for the Behavioral Sciences. Cengage Learning, Boston, Massachusetts, ISBN:978-1-305-50491-2, Pages: 725.

Haraguchi, L., 2016. BIM implementation: A bibliographic study of the benefits and costs involved. Civ. Eng. Archit. English Version, 10: 755-761.

Kekana, T.G., C.O. Aigbavboa and W.D. Thwala, 2014. Building Information Modelling (BIM): Barriers in adoption and implementation strategies in the South Africa construction industry. Proceedings of the International Conference on Emerging Trends in Computer and Image Processing (ICETCIP'14), December 15-16, 2014, Planetary Scientific Research Center, Pattaya, Thailand, pp: 15-16.

Li, J., L. Hou, X. Wang, J. Wang and J. Guo *et al*., 2014. A project-based quantification of BIM benefits. Intl. J. Adv. Rob. Syst., 11: 123-136.

Likert, R., 1932. A technique for the measurement of attitudes. Arch. Psychol., 140: 1-55.

NBIMl., 2017. NBS international BIM report. The national BIM library, UK.

NIBT., 2017. Use of BIM in Indian AEC industry. National Institute of Building Technology, Sharanpur, India.

Nazar, N., 2014. Using the virtual building technology for quantity surveying of buildings. Master Thesis, University of Baghdad, Baghdad, Iraq.

Osman, M.K., 2016. Implementation and potential benefits of Building Information Modeling (BIM) in Sudan construction industry. Master Thesis, Sudan University of Science and Technology, Khartoum, Sudan.

Porwal, A. and K.N. Hewage, 2013. Building Information Modeling (BIM) partnering framework for public construction projects. Autom. Constr., 31: 204-214.

Smith, D.K. and M. Tardif, 2009. Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors and Real Estate Asset Managers. John Wiley & Sons, Hoboken, New Jersey, USA., ISBN:978-0-470-25003-7, Pages: 183.

Stanley, R. and D.P. Thurnell, 2014. The benefits of, and barriers to, implementation of 5D BIM for quantity surveying in New Zealand. Constr. Econ. Build., 14: 105-117.

Succar, B., 2009. Building information modelling framework: A research and delivery foundation for industry stakeholders. Autom. Constr., 18: 357-375.

Zhou, Y., L. Ding, Y. Rao, H. Luo and B. Medjdoub *et al*., 2017. Formulating project-level building information modeling evaluation framework from the perspectives of organizations: A review. Autom. Constr., 81: 44-55.