

RESEARCH PAPER

An Investigation into the Current Situation of Implementing Building Information Modeling (BIM) in Construction Projects in Erbil City, KRG, Iraq

Khalil Ismail Wali*

Department of Civil Engineering, College of Engineering, Salahaddin University-Erbil, Kurdistan Region, Iraq.

ABSTRACT:

Building Information Modeling (BIM) facilitates sharing all participants during the project's lifecycle management by providing shared digital resources for all stakeholders. This study carried out during 2018-2019 as an attempt to understand the current situation and to identify the potential barriers factors facing the BIM implementation in Erbil city, Kurdistan Regional Governorate (KRG)-Iraq. The results analysis of collected data revealed that only 58% of respondents had heard about the BIM against 42% had never heard about BIM. While a majority of 79% said that they had not used BIM; against only 21% said BIM used by their companies. The results of the analysis city showed that the top five significant barriers and obstacles factors encounter the implementation of BIM was the lack of conducting training courses for learning BIM techniques in Erbil city comes in the first rank. Whereas poor education syllabus and training courses in universities and governmental centers in the second rank. While, the Lack of supportive environment by the parties involved in construction and have an impact on the development of construction projects came in the third rank, and poor planning and a coordination with considerations for proper implementation and innovation management in the fourth rank, the lack of experts and technical staff in the field of BIM came in fifth ranks. The primary contribution of this study is to enhance awareness of the benefits of adopting BIM in the construction sector in Erbil city.

KEY WORDS: Building Information Modeling(BIM); Barriers; Motivation; Construction Projects

DOI: <http://dx.doi.org/10.21271/ZJPAS.32.3.2>

ZJPAS (2020) , 32(3);10-19 .

1. INTRODUCTION:

Building Information Modeling (BIM) is the process of developing and adopting a computer-aid model to represent the planning schedule, design, construction, and operation of a facility. BIM technique is a data-rich, object-oriented, from which views and data appropriate to various parties and users' needs can be figured out and analyzed to produce information that can be used for making decisions and to improve the process of completing the facility (America, 2005).

Building Information Modeling (BIM) is the process of developing and adopting a computer-aid model to represent the planning schedule, design, construction, and operation of a facility. BIM technique is a data-rich, object-oriented, from which views and data appropriate to various parties and users' needs can be figured out and analyzed to produce information that can be used for making decisions and to improve the process of completing the facility (America, 2005).

The Handbook of BIM describes BIM as computer-aided modeling technology for managing and creating building information, and it helps architects, engineers, and constructor to visualize the process of constructing to be built in a simulated environment to classify any potential

* **Corresponding Author:**

Khalil Ismail Wali

E-mail: khalil.wali@su.edu.krd

Article History:

Received: 22/09/2019

Accepted: 24/11/2019

Published: 15/06 /2020

design, construction, or work aspects. BIM technology represents a new approach within AEC. (Eastman et al., 2011)

The applications of BIM assists in generating the geometry, spatial relationships, geographic information, quantities and properties of building elements, cost estimation, material inventories, and preparation of project schedule. This model can be used to demonstrate the entire building life cycle (Azhar et al., 2008). On the other hand, the parties involved in adopting the BIM model uses specific software that suits with their required task, which constitutes a barrier to the exchange of data to and from the model. Moreover. Besides, poor support from senior management staff is one of the difficulties the application of BIM (Herold et al., 2008).

Regarding the legal side, the shortage of BIM standard contracts is one of the other fences for many companies and organizations (Becerik-Gerber and Kent, 2010). The government institutions require taking the leadership role in encouraging the implementation of the BIM. Also, it is necessary to cooperate with other parties who have an impact on the development of projects, such as specialists and engineers in the private sector, contractors (Hardin, 2009). BIM Model deliverables include lean construction principles, green environment policies, and entire life cycle costing. A shared interdisciplinary model is essential to provide two-way access to project stakeholders, which will eventually facilitate Integrated Project Delivery (IPD) (Kjartansdóttir et al., 2017).

The roots of BIM technique date back to the late 1970s and early 1980s in the USA and Europe through the parametric modeling researches that have been conducted in that era. However, the implementation of this technology did not practically apply in the AEC projects until the mid-2000s (Eastman et al., 2011). BIM usage is increasing across the world. In the USA and Canada, the adoption of BIM is growing throughout the states, 18% of owners used BIM in 2009, then increased to 30% in 2011 and around 44% in 2014. Recently, about 60% of owners

using BIM in their projects (AUTODESK, 2014). According to the survey made by the Egyptian researcher, stated that BIM technology is being widely implemented in the Middle Eastern countries, especially in UAE and Qatar, which come at the top of the list. Only Iraq is the only country that has not implemented this technology yet (Egyptian, 2017).

2. MATERIALS AND METHODS

This study investigates the current situation and to identify the potential barriers factors of BIM implementation in the construction sector in Erbil city. To achieve the objective of this study, the field survey method conducted through a particular form of a questionnaire prepared to gather the data and information from engineers and professionals working in both the public and private construction sectors in Erbil city. The designed questionnaire comprises three main sections as follows:

Section I: This section related to general information of the respondents such as; name, nationality, age, and gender, and the educational level.

Section II: In this section, the current practices and knowledge of the respondents about the BIM were examined, which included questions about whether the respondent has heard of BIM or not.

Section III: In this section, a list of 21 barriers factors facing BIM implementation were listed together with the weight of importance by using the five- Likert scale. The scale comprises; 1: Extremely disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Highly agree (Likert, 1932).

A total of 150 forms of the questionnaire distributed, only 125 completed forms returned and accepted at a rate of 83.3%, directed to the target respondents of professional engineers and academic staff working in 25 public and private sectors of construction projects, governmental institutions, and universities academic staff in Erbil city as presented in Table 1.

Table 1. List of Projects and Organizations covered by the survey in Erbil city

Private Sectors	Public Sectors
1. Mihrabani Hospital	1. 120 m ring road
2. German Hospital	2. Erbil Municipality projects
3. Majidi Hospital	3. Ankawa Municipality projects
4. Runaky Towers	4. Erbil Municipality Engineers
5. Cristal Hotel 2	5. Ankawa Municipality Engineers
6. New US Consulate	6. Sallahadin University academic staff
7. Majidi Mall 2	7. Ministry of Municipality&Turisum
8. Justice Tower	8. Ministry of Construction & Housing
9. Empire Wing Apartments	9. Directorate of Education Projects
10. Four Towers Buildings	10. Directorate of Roads & highways
11. Greenland Residential Houses	
12. Greenland Overpass	
13. Zanyari Apartments	
14. International Tishk University	
15. Cihan University-Erbil	

3. RESULTS AND DISCUSSION

3.1. General Information for Respondents

Table 2 shows the distribution of the respondent's demographic characteristics and classifications in terms of affiliation, gender, age, category of experience, and specialization. The results analysis showed that the respondents affiliation of 44.% from the private sector, 38.% from the

public sector, and 18% from both the private and public sectors. The respondents' specialization was 45% civil engineer, 30% architecture engineer, 10% electrical engineer, 10% mechanical engineer and 5% other such as (dam and water resource engineers, software engineers, and roadway and highway engineers).

Table 2. The respondent's profile.

Descriptive	Characteristic	Percentage
Work Sector	Private	44%
	Public	38%
	Both	18%
Gender	Male	80%
	Female	20%
Age	20-30	17%
	31-40	28%
	41-50	30%
	More than 51	25%
Work Experience	Less than two years	0 %
	Two to five years	12%
	Five to ten years	25%
	More than ten years	63%
Specialization	Civil Engineer	45%
	Architect Engineer	30%
	Electrical Engineer	10%
	Mechanical Engineer	10%
	Other:	5%

3.2. Current Situation of BIM Implementation in Erbil city

To examine the respondent's knowledge of BIM technique, they questioned whether they had heard about the BIM technology or not; 58 % of them answered "yes," and 42% said "No." as shown in Figure 1. This finding indicates a critical state that means about half of the respondents yet not heard about the BIM technology application in Erbil city.

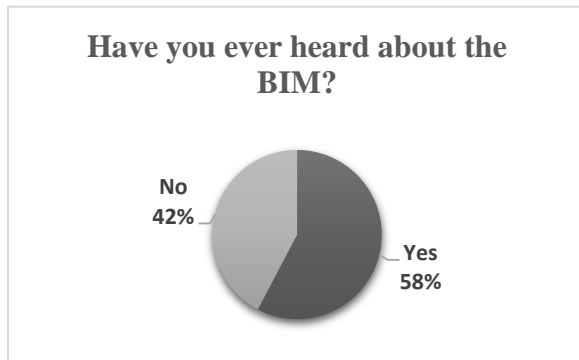


Figure 1. Percentage of hearing on BIM tool

When respondents questioned whether their company or organization in which they employed was using BIM, the majority of 77% answered "No" against only 23% answered "Yes" as shown in Figure 3.

To examine the current level of knowledge on BIM techniques and applications, the respondents

Figure 2 illustrates the respondent's source of knowledge on BIM, the majority of 85% of the respondents indicating they self-taught on BIM which comprises; (10% self-taught, 22% personal participating in conferences, 15% reading article and 12% from other sources) against only 5% got their knowledge by training course and 15% worked with companies using BIM. This finding indicates the absence of official and governmental intervention to enhance BIM adoption.

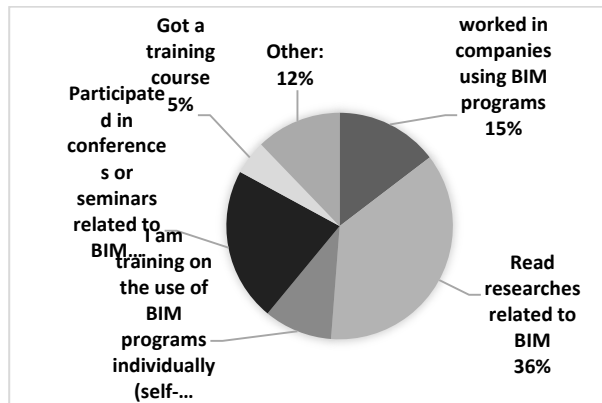


Figure 2. Respondent's sources of BIM knowledge

questioned to describe the current level of understanding of BIM in Architecture, Engineering and Construction industry (AEC) in Erbil city. 83% of the respondents said between low and very low level, while only 15% said medium against 2% said high, as shown in Figure 4.

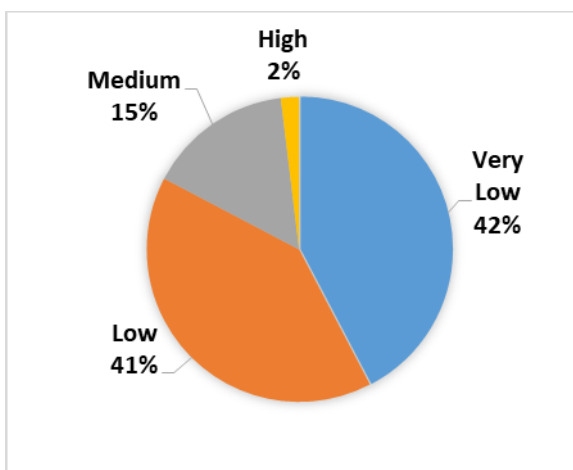
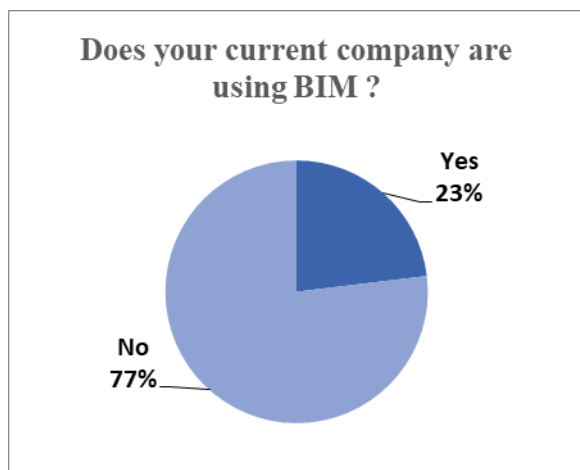


Figure 3. Respondent's Companies experience of BIM **Figure 4. Respondent's assessment of BIM Knowledge**

Figure 5 represents the respondent's expectations on the development of BIM implementation in Erbil city in coming ten years (up to 2030), 60% of the respondents said "medium," 23% "low and very low", while only 17% said, "high and very high."

When the respondents asked about their opinion on the reasons behind the lack of knowledge and experience on BIM technique, the majority of 53% said the cause is due to the lack of educational courses about BIM in universities, and 18% reported that not officially being forced to use BIM in Erbil city as shown in Figure 6.

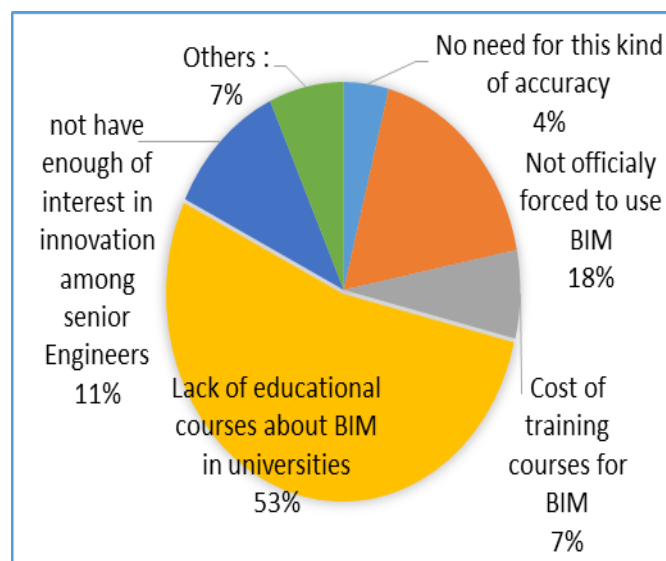
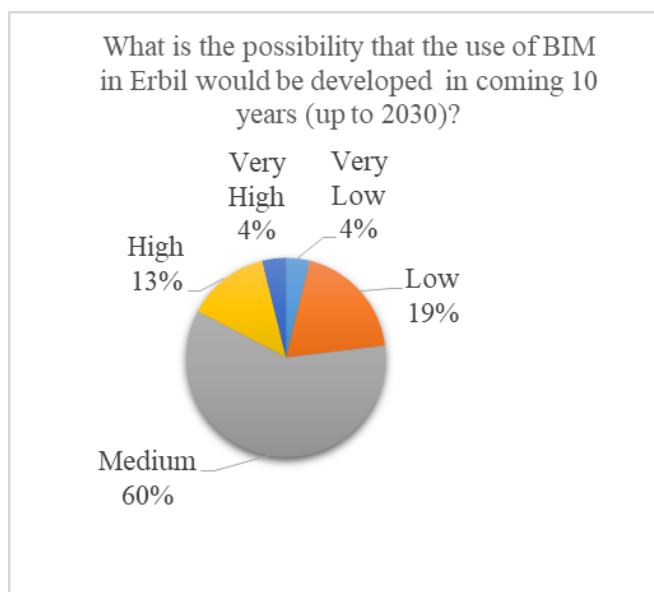


Figure 5. BIM adoption perception over the next ten years.

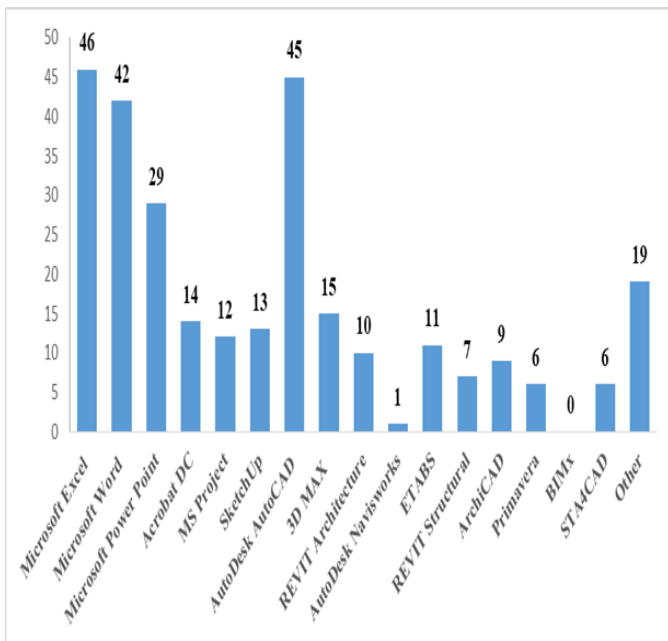


Figure 7. Software used by respondents 1

Figure 6. Reasons for lack of knowledge on BIM technique

Furthermore, Figure 7 shows the current software and project management tools used by the respondents in Erbil city, the majority of 46% indicates that the Microsoft Excel mostly used, while Autodesk CAD came in the second rank of 45% , Revit at 10% and ArchiCAD 9%, whereas, 0% (none) of the target respondents used BIMx as an integrated tool in Erbil city

4. DATA ANALYSIS METHODS

4.1 Relative Importance Index (RII)

To analysis the collected data of this survey statistically, the relative importance index (RII) was used as a criterion to rank the importance of barriers factors facing the BIM implementation. RII calculated by using equation (1) and (2) (Krauth, 2000).

$$RII = \frac{\sum W}{(A * N)} \text{-----(1)}$$

$$RII = \frac{5(n5)+4(n4)+3(n3)+2(n2)+1(n1)}{5(n5+n4+n3+n2+n1)} \text{-----(2)}$$

Where:

W: The Likert weight ranging from 1 to 5 selected by the respondents.

A: Indicates the highest weight (which equals 5 in this survey)

N: Is refers to the total number of respondents.

4.2 Statistical reliability analysis

Calculating the value of Cronbach’s alpha was used as a tool to measure the internal consistency of items related to the barriers factors facing the

BIM implementation. Corbanoch’s alpha ranges from 0.0 to 1.0, and the closer to 1.0 indicates the high degree of reliability range (Yockey, 2018). Table 3 shows the classification for the degree of reliability concerning the value of the Cronbach’s alpha coefficient determined by using the SPSS package. For the questionnaire data collected as indicated in the part III-BIM potential barriers, the result of Cronbach’s alpha evaluation was 0.992, which represents the excellent limit, and this result confirms the acceptable reliability of this part, as shown in Table 4 (Hinton et al., 2004).

Table 4. Reliability cutoff values(Hinton et al., 2004).

Cronbach’s alpha	Degree of Reliability
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Table 3. Reliability Statistics –Cronbach’s Alpha

Cronbach's Alpha- Barriers	Cronbach's Alpha Based on Standardized Items	No. of Items
0.992	0.993	21

4.3 The potential barriers facing BIM implementation in Erbil city

The results of RII analysis as listed in Table 5, showed that “The lack of training courses available for learning BIM technique in Erbil city.” was the most significant factor of BIM using with an essential rate of RII=0.8385 which came in the first rank.

The second potential barrier for using BIM was “Poor education and training in universities and

government centers.” with RII=0.8192, came in the second rank.

While in the third ranks came the “Lack of supportive environment by government and other parties who have an impact on the development in Erbil city.” And “lack of educational syllabus in engineering colleges in Erbil city to use such sophisticated packages and tools,” both factors were with RII=0.8154.

Table 5. Potential barriers facing BIM implementation in Erbil city

No.	Barriers factors	RII	Rank
1	Absence of client demand for using BIM in their projects	0.7923	6
2	The cost of BIM and its updates.	0.7231	10
3	The cost of the hardware required with particular specifications for the operation of BIM.	0.7192	11
4	The cost needed for training courses about BIM Technique.	0.7577	8
5	The lack of training courses available for learning BIM Technique in Erbil city-KRG.	0.8385	1
6	The cost of recruitment of BIM specialists and additional staff.	0.7692	7
7	Time to apply BIM and its negative impact on current productivity.	0.5808	16
8	Lack of supportive environment by government and other parties who have an impact on the development in Erbil city.	0.8154	3
9	Lack of experts in the field of BIM.	0.8000	5
10	Insufficient BIM standards, protocols, and rules in Erbil city-KRG.	0.7577	8
11	The belief that existing techniques are adequate, BIM is not needed.	0.6269	13
12	Problems related to interoperability between BIM Technique.	0.6192	14
13	Poor education and training in universities and government centers.	0.8192	2
14	Poor planning and a coordinated approach with considerations for Implementation and innovation management	0.8038	4
15	Poor cooperation between different disciplines.	0.7692	7
16	Exposure to the risks associated with the intellectual property model and the cost of copyright and publishing.	0.6154	15

17	Lack of educational syllabus in engineering colleges in Erbil-KRG to use such sophisticated packages and tools.	0.8154	3
18	Lack of serious exposure to BIM by holding seminars and conferences about its benefits	0.7923	6
19	Insufficient skills among engineers and difficulty in learning BIM software.	0.7231	10
20	The need for uninterrupted power and a secure internet connection that can accommodate the vast amount of information.	0.6462	12
21	The strong resistance to change, especially with older ages (owners, contractors and/or engineers) and their attachment to only the software they are familiar to them.	0.7538	9

4.4 Comparison of findings with other countries

In a comparison of three top significant barriers factors of the current study in Erbil city with the researches in other countries, showing the similarity in some barriers factor to the research

findings in Iran (Hosseini et al., 2015), Jordan (Matarneh and Hamed, 2017), Kuwait (Abdulfattah et al., 2017), and Qatar (Ahmed et al., 2014), as shown in Table 6.

Table 6. Comparison of three top BIM barriers between ten various countries

No.	Country[ref.]	Three top BIM barriers
1.	UK (NBS, 2015)	<ul style="list-style-type: none"> • Shortage of experts • Lack of training • The owner did not request the use of BIM
2.	USA (Construction, 2012)	<ul style="list-style-type: none"> • Cost of software • Required hardware upgrades too expensive • There is no sufficient time to evaluate it
3.	SWEDEN (Lahdou and Zetterman, 2011)	<ul style="list-style-type: none"> • Personal opinions towards BIM • The strong resistance to change • It is hard to find stakeholders that have the required competence to participate in the BIM project.
4.	MALAYSIA(Zahrizan et al., 2014)	<ul style="list-style-type: none"> • Weak knowledge of BIM • The owner did not request the use of BIM • The strong resistance to change
5.	INDIA (Kushwaha, 2016)	<ul style="list-style-type: none"> • Weak competition • Cost of software • The owner requests the use of BIM only at certain stage
6.	NIGERIA(Abubakar et al., 2014)	<ul style="list-style-type: none"> • The resistance to change • The need for BIM contracts • Cost of training
7.	QATAR (Ahmed et al., 2014)	<ul style="list-style-type: none"> • Shortage of experts • The need for special contracts • The strong resistance to change
8.	KUWAIT (Abdulfattah et al., 2017)	<ul style="list-style-type: none"> • Lack of training • Lack of Engineer's skill • Weak knowledge of BIM

9.	JORDAN (Matarneh and Hamed, 2017)	<ul style="list-style-type: none"> • Weak governmental efforts • Insufficient BIM standards and protocols • Weak knowledge of BIM
10.	IRAN (Hosseini et al., 2015)	<ul style="list-style-type: none"> • Lack of attention by policymakers and the government. • Lack of knowledge on BIM adoption process. • Lack of support from managers to accept changing current practices.
11.	ERBIL-KURDISTAN-IRAQ [current study]	<ul style="list-style-type: none"> • The lack of training courses for learning BIM techniques • Poor education and training in universities and government centers. • Lack of governmental support and other parties.

5.CONCLUSIONS

This study was aimed to explore the current state of BIM implementation and to find out the most probable barriers facing BIM adopting in Erbil city based on the opinions of professional staff involved in both the public and private sectors. According to the results and findings showed that 42% of the target respondents not heard on BIM, while 58% said they heard about BIM. The study also revealed that 77% of the companies involved in the construction sector not using BIM, against only 23% using BIM, whereas, 83% of the respondents believed that the current level of knowledge on BIM in Erbil city still in a range of low and very low level.

In a question of the reasons behind the lack of knowledge on BIM, 53% said due to the lack of educational courses in universities, and 18% said due to BIM still not being enforced to be used.

It was found that the majority of 46% of the respondents using Microsoft Excel, and 45% said using Autodesk CAD, whereas 0% (none) of the respondents used BIM technology.

The findings also identified the most significant barriers factors facing the BIM implementation in

Erbil city, which comprises the lack of training courses available for learning BIM technique particularly in Erbil city, Poor education and training in universities and government institutions, Lack of educational syllabus in engineering colleges, Lack of supportive environment by government agencies.

The results of this study reveal that the BIM implementation in Erbil city during surveying 2018-2019 is still in the beginning phase, and it is facing several barriers and obstacles as well as ignorance from various parties involved in the construction sector. Therefore, it is recommended to initiate supporting laws and regulations to enhance the adopting of BIM in architecture, engineering, and construction industry in Erbil city. Facilitate the training courses, conducting conferences and seminars to promote BIM adoption. Finally, there is a need to improve the syllabus and curriculum of engineering colleges for undergraduate and postgraduate studies, and encouraging the researches and studies to transfer the technology and expertise in the field of BIM technology.

REFERENCES

- ABDUL FATTAH, N. M., KHALAFALLAH, A. M. & KARTAM, N. A., 2017. Lack of BIM training: investigating practical solutions for the State of Kuwait. *World Academy of Science, Engineering and Technology, International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering*, 11, 1050-1056.
- ABUBAKAR, M., IBRAHIM, Y., KADO, D. & BALA, K. 2014. Contractors' perception of the factors affecting Building Information Modelling (BIM) adoption in the Nigerian Construction Industry.

Computing in civil and building engineering (2014).

- AHMED, S. M., EMAM, H. H. & FARRELL, P. Barriers to BIM/4D implementation in Qatar. The 1st international conference of cib middle east & north Africa conference, 2014. 533-547.
- AMERICA, A. G. C. O. 2005. *The Contractor's Guide to BIM*, Las Vegas, NV AGC Research Foundation.
- AUTODESK. 2014. *The Value of BIM for Owners: Save Time and Money During the Building Lifecycle* [Online]. Available: <http://damassets.autodesk.net/content/dam/autodesk>

- [/www/solutions/bim/BIM_for_Owners.pdf](http://www/solutions/bim/BIM_for_Owners.pdf).
[Accessed 23-Dec 2018].
- AZHAR, S. 2011. Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. *Leadership and management in engineering*, 11, 241-252.
- AZHAR, S., NADEEM, A., MOK, J. Y. & LEUNG, B. H. Building Information Modeling (BIM): A new paradigm for visual interactive modeling and simulation for construction projects. Proc., First International Conference on Construction in Developing Countries, 2008. 435-46.
- BECERIK-GERBER, B. & KENT, D. 2010. Implementation of integrated project delivery and building information modeling on a small commercial project.
- CONSTRUCTION, M.-H. 2012. The business value of BIM in North America: multi-year trend analysis and user ratings (2007-2012). *Smart Market Report*.
- EASTMAN, C., TEICHOLZ, P., SACKS, R. & LISTON, K. 2011. *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*, John Wiley & Sons.
- EGYPTIAN, R. 2017. *Application of BIM in the Middle East* [Online]. Available: <https://www.egyres.com/articles/>[Accessed 20-Dec 2018].
- HARDIN, B. 2009. *BIM and Construction Management: proven Tools, Methods, and Workflows* Wiley Publishing Inc. *Indianapolis, Indiana*.
- HEROLD, D. M., FEDOR, D. B., CALDWELL, S. & LIU, Y. 2008. The effects of transformational and change leadership on employees' commitment to a change: A multilevel study. *Journal of applied psychology*, 93, 346.
- HINTON, P., BROWNLOW, C., MCMURRAY, I. & COZENS, B. 2004. Using SPSS to analyze questionnaires: Reliability. *SPSS explained*, 356-366.
- HOSSEINI, M. R., AZARI, E., TIVENDALE, L. & CHILESHE, N. Barriers to adoption of building information modeling (BIM) in Iran: Preliminary results. The 6th International Conference on Engineering, Project, and Production Management (EPPM2015), Gold Coast, Australia, 2015.
- KJARTANSDÓTTIR, I. B., MORDUE, S., NOWAK, P., PHILP, D. & SNÆBJÖRNSSON, J. T. 2017. *Building Information Modelling-BIM*, Civil Engineering Faculty of Warsaw University of Technology Warsaw.
- KRAUTH, J. 2000. *Experimental design: a handbook and dictionary for medical and behavioral research*, Elsevier.
- KUSHWAHA, V. 2016. Contribution of building information modeling (BIM) to solve problems in architecture, engineering and construction (AEC) industry and addressing barriers to implementation of BIM. *Int. Res. J. Eng. Technol*, 3, 100-105.
- LAHDOU, R. & ZETTERMAN, D., 2011. BIM for Project Managers How project managers can utilize BIM in construction projects.
- LIKERT, R., 1932. A technique for the measurement of attitudes. *Archives of psychology*.
- MATARNEH, R. & HAMED, S., 2017. Barriers to the adoption of building information modeling in the Jordanian building industry. *Open Journal of Civil Engineering*, 7, 325.
- NBS 2015. NBS International BIM Report, UK.
- YOCKEY, R. D. 2018. *SPSS Demystified: A simple guide and reference*, Routledge.
- ZAHRIZAN, Z., Ali, N. M., HARON, A. T., MARSHALL-PONTING, A. & HAMID, Z. A. 2014. Exploring the barriers and driving factors in implementing building information modeling (BIM) in the Malaysian construction industry: A preliminary study. *Journal of the Institution of Engineers, Malaysia*, 75, 1-10.