BIM Implementation in Construction Projects in Jordan

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Abstract:

Construction projects are well known for their complexity and ambiguity. Construction companies can face so many problems related to the construction project in all there stages due to the lack of communication between all those who involved in the project, Building Information Modeling (BIM) could be the solution. This study aims :(1) to identify the essential barriers facing BIM implementation in Jordan. (2) Defined the level of BIM maturity by Bew-Richards BIM maturity level in Jordan. (3) Discus the BIM implementation in one of the companies in Jordan (Dar Al-Omran for infrastructure Company). Through literature review, surveys and interviews with project managers in Dar Al-Omran Company, this study will help establish a knowledge base about BIM situation in Jordan.

Keywords: Construction projects, BIM maturity, Questionnaire surveys.

تطبيق نمذجة معلومات البناء في مشاريع البناء في الأردن

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الملخص:

تشتهر مشاريع البناء بتعقيدها وغموضها. يمكن أن تواجه شركات المقاولات الكثير من المشاكل المتعلقة بمشروع البناء في جميع مراحلها بسبب عدم التواصل بين جميع المشاركين في المشروع ، يمكن أن تكون نمذجة معلومات البناء (BIM) هي الحل. تهدف هذه الدراسة إلى: (1) التعرف على المعوقات الأساسية التي تواجه تطبيق نمذجة معلومات البناء في الأردن. (2) تم تحديد مستوى نضج BIM من خلال مستوى نضج Bew-Richards BIM في الأردن. (3) مناقشة تطبيق BIM في إحدى الشركات الأردنية (شركة دار العمران للبنية التحتية). من خلال مراجعة الأدبيات والدراسات الاستقصائية والمقابلات مع مديري المشاريع في شركة دار العمران، ستساعد هذه الدراسة في إنشاء قاعدة معرفية حول وضع BIM في الأردن.

الكلمات المفتاحية: مشاريع البناء ، نضج نمذجة معلومات البناء ، استطلاعات الرأي.

1. Introduction:

Problems related to construction projects appear in all project phases and especially in the implementation phase, like:

a) Design errors like clash of building elements.
b) Wasted money and time for variation orders.
c) Client satisfaction.

Such problems and more may be solved if there is a better way to communicate between all those who involved in the project, including designers, officials and implementers. And a clear vision of the project elements by 3D model gives a representation of all project information and makes it accessible, easy to look at or view and modify which saves a lot of effort, time, avert design errors and the result is much better upon construction phase.

Here comes the concept of Building Information Modeling (BIM) which is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.

However, the implementation of this process is still largely inactive, despite the urgent need to adopt it in construction projects in our country, Jordan.

This study aims (1) to identify the essential barriers faces BIM implementation in Jordan from Jordanian engineer's point of view (2) The level of BIM maturity by Bew-Richards BIM maturity level in Jordan (3) discus the BIM implementation in Dar Al-Omran for Infrastructure Company as one of the most important companies in Jordan.

2. THE BIM IMPLEMENTATION BENEFITS

According to (Latiffi, Mohd et al. 2013) implementing BIM in construction projects can overcome construction problems such as delay, clash of design and disputes between construction team works.

The benefits of BIM adoption in construction projects can be seen in each construction phase. Like:

1. A platform to help architects initiate the process of better and more accurate design.
2. Gives support to design, scheduling, and budgeting of built assets.
3. A visualization of the construction process through a 4D model greatly enhances understanding of processes and helps in avoiding design errors.
4. The speed of design can be increased by using BIM tools.

5. Saves 10% of contract value through clash detection.
6. Helps to achieve 3% of cost estimation accuracy.
7. Less drawing coordination issues and clash errors.

BIM gives many benefits in construction projects, and its adoption can increase the quality of construction projects. Based on the benefits discussed, it is clear that BIM is useful in assisting construction engineers to construct small or high-risk projects successfully. Moreover, through BIM, problems such as delay increase in construction cost, accidents on construction sites and less disagreement between construction engineers.

3. Barriers of BIM implementation:

literature review was done to identify all BIM implementation barriers that faces all types of construction projects according to (Tan, Chen et al. 2019) and here are some of them :

A. Difficulty in adapting to the BIM process

(Lu and Korman 2010)and (Elmualim and Gilder 2014) found that one of the most important challenges of BIM implementation in construction projects is the adaptation to BIM technology and processes. According to (Yan and Demian 2008) stakeholders, have to deal with the difficulty in effectively changing the existing process, which significantly restrict BIM implementation process.

B. Resistance to change the implementation of BIM

BIM implementation changes project delivery and perhaps the organization's structure (Eastman, Eastman et al. 2011). And that's the reason that the stakeholders in the construction field are known to be resistant to change. They are used to traditional design methods and unwilling to adopt new technologies. pushing theme to use BIM can be extremely difficult ((Arayici, Coates et al. 2011); (Panuwatwanich and Peansupap 2013); (Yan and Demian 2008)).

C. Negative attitude towards data sharing

Explaining in (Zhang, Azhar et al. 2018) that Stakeholders generally do not like to share data with each other. Considering the fact that implementation of BIM needs collaboration and data integration, negative attitudes towards data sharing affect the success of BIM implementation in construction projects.

D. Misunderstanding of BIM

The performance of BIM-based projects depends on its stakeholders' understanding BIM (Khosrowshahi and Arayici 2012). Misunderstanding BIM will obstruction achieving all the benefits of BIM (Panuwatwanich and Peansupap 2013) and lead to serious risks (Zhang, Azhar et al. 2018).

E. Cost and time required for training

(Eadie, Odeyinka et al. 2014) confirmed that stakeholders' concern about spending a lot of time and money on labor training, as well as under or overestimating the time and resources they have allocated for such training, (Yan and Demian 2008). Therefore, the cost and time required for training will restrict the BIM implementation process.

The barriers and challenges of BIM implementation in Jordan are listed in (AL-Btoush and Haron) and More than 70% agreed with the following Barriers :

1. Firms are not familiar enough with BIM use.
2. Reluctance to initiate new workflows or train staff.
3. Benefits from BIM implementation do not outweigh the costs to implement it.
4. Lacks the capital to invest in having started with hardware and software.
5. BIM is too risky from a liability standpoint to warrant its use.
6. Resistance to culture change.
7. No demand for BIM use.

4. BIM adoption in Dar Al-Omran for Infrastructure Company

Dar Al-Omran for Infrastructure Company is established in 1979; they develop tailored and environmentally sound infrastructure solutions and provide sustainable benefits.

In Dar Al-Omran for Infrastructure Company, as there are many large projects that require a large number of engineers from all disciplines in addition to the multiplicity of 3D design programs like civil3D and Rivet. This sometimes causes a lot of wasted time between the designers, mistakes that related to the latest version of work, whereas the project team communicates through e-mail.

5. Methodology and Data Presentation

Initially, literature review will establish the knowledge base by identifying the needs and obstacles of BIM implementation.

A survey questionnaire aimed to validate the common barriers that face the BIM implantation that had been identified through the literature review in addition to other questions in order to identify the real situation and issues of BIM implementation in Jordan. Ultimately, a total of 30 completed survey questionnaires were received, tabulated and analyzed.

The purpose of the survey was to: (1) Identify the barriers that face the BIM implementation in Jordan. (2) Wither the term BIM is known and is it fully applied in Jordanian companies. (3)BIM maturity levels in Jordanian companies. The first part of the survey questionnaire captured A. knowledge of Jordanian engineers of term BIM .B. Does it applied in their work place. C. Is there a need to apply BIM in their workplace according to their point of view? .The second part listed the common barriers that face the BIM implantation asking them about wither it could be faced in their workplace. The third part listed the 3 maturity levels by Bew-Richards BIM maturity level asking engineers to identify the maturity level in their workplace. The respondents were asked to answer by yes/no for all questions. Out of the 50 questionnaires sent out, 30 sets of completed survey questionnaires were received and analyzed.

In addition, Interviews with project managers in Dar Al Omran, focuses on knowing the readiness of Dar Al-Omran to adopt BIM, their expectations for the future development in this area and if there are any obstacles that will prevent its application to their new projects. This study engaged two engineers from two deferent disciplines and one project manager for interview, all of them having more than 7 years of experience in construction projects.

6. Data Analysis

The following subsections discuss the analysis results on the various survey questionnaire and interviews. Table 1 summarizes the results with specific questions of the survey questionnaire categorized into four sections, their yes/no answers scores, and the percentage of yes answers.

The analysis of all the data will give a clear idea about the BIM implementation in Dar Al-Omran as one of the important companies in Jordan which will help them start BIM implementation in the future hopefully. And give us an idea about the real situation and issues that faces BIM implementation in Jordan from engineers point of view.

6.1. Data Analysis and discussion for survey questionnaire

The distribution of the respondents' answers was found to be as follow:

Section one:

80% of this sample heard about BIM term which is a very high percentage, 83% of this sample BIM is not adopted in their work place indicating that BIM is not widely applied in Jordanian companies and 93% sees that it should be implemented in construction projects in Jordan.

Section two:

The most common barriers that this sample thinks that they are exist in their work place ordinate descending according to the percentage of approval:

1. 90% Resistance to change by employees and decision-makers
2. 90% Lack of experts in BIM.
3. 87% Traditional methods of implementing engineering projects.
4. 80% less demand from client side.
5. 70% less benefit from BIM for small projects.
6. 63% High cost of implementing BIM.

The high percentage of all the previous barriers indicate that all of them are exist in Jordanian companies and should be considered when it comes to BIM implementation .

Section three:

BIM maturity levels by Bew-Richards BIM maturity levels; this sample thinks that level 1 is the most common in Jordanian companies while the percent is too low for maturity level number 3 which indicates that such a level is not reached in Jordan yet.

Section four:

60% which is a high percent thinks that BIM will be adopted in their workplace in the following years indicating that Jordanian companies are in the right path of starting BIM implementation in their projects.

6.2. Interviews data analysis:

From the interviews that where established with three of Dar Al-Omran for Infrastructure Company engineers they are well educated about BIM in general because of the training the company gives them in the past few months about this topic. In addition to the BIM adoption efforts in some of their small projects, the good news was that the company is having a bursary to have an expert company in

BIM implementation in order to help Dar Al-Omran to fully adopt BIM in their projects soon.

They think that the rail maturity level in there company is level 1 to 2 while they are experiencing a new method of obtaining the location data by a 3D laser scanner. The barriers of BIM implementation in their company:

1. The lack of BIM experts.
2. Resistance to change by employees and decision-makers.
3. Less demand from client side in Jordan.

Finally they are blessed to have fully BIM adoption in their company projects because BIM will add the following benefits for them:

1. It opens wider areas in dealing with new customers locally and globally.
2. Less design errors and clash in the implementation phase.
3. Customer satisfaction by having a clear idea about his/her project.

Easier and faster way when it comes to dealing with large projects.

Table 1: Questionnaire results

Questionnaire sections and questions	Answers		Percent of (yes) answers (%)
	yes	no	
First section (After reading the definition of BIM)			
Have you ever heard of Building Information Modeling?	24	6	80
Is it applied in projects that belong to your organization?	25	5	83
By definition, do you see it is an important process to be adopted in Jordan?	28	2	93
Second section (barriers facing BIM implementation)			
Less demand from client side *	24	6	80
Less benefit from BIM for small projects *	21	9	70
High cost of implementing BIM *	19	11	63
Lack of experts in BIM *	27	3	90
Traditional methods of implementing engineering projects *	26	4	87
Resistance to change by employees and decision-makers *	27	3	90
Third section (BIM maturity levels)			
Level 0: This could refer to a scenario where scanning information is obtained manually on site with tapes and vacuum levels, is drawn with a CAD package in an unorganized format, and then attached using paper pieces.	17	13	57

Level 1: This could be a scenario where the location data is obtained digitally using (electronic distance scale, known as "Total Station") and then transferred to 2D and 3D CAD environment that uses standard data structures.	18	12	60
Level 2: This would be a scenario where the location data is obtained digitally in a 3D format in nature using a laser scanner, for example, which is then transferred to a 3D modeling environment with specific and specific standards of discipline, but communicates and collaborates with other disciplines using standards Industry interface tools (such as IFCs) .	9	21	30
Level 3: It is all about managing the entire life cycle which is called Open BIM, assuming that there is complete cooperation between all the parties involved in planning, creating or operating it throughout its life cycle.	3	27	10
Fourth section (Summary)			
Do you see that building information modeling can be applied in your organization in the coming years	18	12	60
Would you choose to adopt BIM or not	22	8	73

7. Summary and Conclusion

This paper introduces the main barriers facing BIM implementation in Jordan and presents a survey which was done to determine the score for each barrier from the perspective of Jordanian engineers.

These barriers are:

1. Resistance to change by employees and decision-makers
2. Lack of experts in BIM.
3. Traditional methods of implementing engineering projects.
4. Less demand from client side.
5. Less benefit from BIM for small projects.
6. High cost of implementing BIM.

BIM maturity level in Jordanian companies is ranged from level 1 to 2. The awareness of Jordanian engineers about BIM term is very good according to the high percentage of respondents who agreed for knowing the BIM term and the highly educated employees of Dar Al-Omran Company.

Finally the paper discussed BIM implementation benefits in one of the most important companies in Jordan (Dar Al-Omran for Infrastructure Company) from the perspective of its employees.

8. Recommendations

- It is very important to increase the bracts of Jordanian engineers with BIM presses in **detail** in order to follow the increasing BIM implementation demand around the world.
- Working with BIM experts to ensure the best results of BIM implementation in Jordanian companies.
- All companies in Jordan most have BIM implementation in their future plans.
- BIM free training crosses should be held by the Jordan Engineers Association.
- Government should do more efforts for BIM implementation in Jordan and courage the construction companies in that area.
- More studies should be established in order to find practical solutions for the barriers facing BIM implementation in Jordan.

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