Study of the Quality Concepts Implementation in the Construction of Projects in Saudi Arabia by using Building Information Modelling (BIM)

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Abstract*: The concepts of Quality are closely associated with the concept of Building Information Modeling (BIM) in managing and improving the execution of construction projects that achieve a better performance in saving time, satisfying the customers, profits increasing, coast reduction, achieving safety requirements and maintaining the coordination and the integrity with the project basic parameters (time, cost and quality). Therefore, the purpose of the study is to address the importance and to assess the impact of the application of Building Information Modeling (BIM) on the implementation of construction projects in Saudi Arabia and the extent of how it is related to the Quality concepts over the last ten years.

In order to achieve the purpose of the study, the descriptive analytical approach was used by distributing 12 questionnaires in engineering offices and construction companies. SPSS program was used in order to process the collected data.

The study found that the construction projects in Saudi Arabia still suffer from the weaknesses in the application of Building Information Modeling (BIM), lack of administrative, scientific and technical competencies and poor application of the standards of the Quality concepts in the execution of construction projects.

Keywords: Quality, BIM, Building Information Modeling, construction projects.

I. INTRODUCTION

Over the past decade, the construction division in Saudi Arabia has witnessed a remarkable growth. It should be noted that construction developments are deemed to be one of the most productive investment stages throughout the world. In modern times, in addition to construction projects concentration on customary accomplishments, they also further concentrate on quality, cost-effectiveness, cost reduction, and conservation of time and venture (Abazid and Harb, 2018) and (Abazid, 2017)**.**

With the many advancements occurring, construction projects, especially those in Saudi Arabia, have become more obscure and difficile to maintain. Various problems are faced by contractors in planning and executing construction works including uncoordinated drawings and specification, absent relevant data, and deferred delivery of design material. Due to the former influences aforementioned, many regions especially Saudi Arabia, were led to practice and exploit modern methodologies and essentials in project implementation and also to work on increasing specs, requirements and conditions. These practices will allow for the presence of more precise productions, providing simpler implementing techniques and making operations easier, additionally, contractors will become vigilantly involved in utilizing the quality perceptions in all the phases of the project implementation. (Nouban and Abazid, 2017) and (Abazid and Gokcekus, 2019).

Developments in the information and communication technology, other known as the ICT, have been evolving at a rapid pace due to the growing complications of projects. Throughout the former decade, the construction industry witnessed a major alteration in ICT which was the generation of Building Information Modelling (BIM) as the innovative Computer Aided Design (CAD) architype to be utilized in industrial and academic facilities (Succar, 2009). Presently, BIM is the utmost general denomination for a modern technique in handling the design, construction and preservation of structures. The BIM can be identified as "an array of interrelating guidelines, developments, and tools creating an approach to administer the fundamental structure design and project information in a digital system throughout the structure's life-cycle" (Succar, 2009).

Overall, hypothetical advances in the Building Information Modelling (BIM) imply that in addition to its aid in geometric display of a structure's execution, it also helps in the administration of construction projects and the functional quality manipulation.

Moreover, based on enquiries in various areas, Total Quality Management and Building Information Modelling (BIM) signify affiliation in implementation and effectiveness of establishments; which also resulted in postulation that enhanced data will ultimately precede to enhanced result of quality within construction works. (Wheaton and Schrott, 2018), (Pheng and Teo, 2003), (Fatimah. F. et al. 2016).

Consequently, in order to accomplish the concept of Total Quality Management within the implementation of the construction projects in Saudi Arabia, this following research will explore the assessment of the tangible utilization of the Building Information Modelling (BIM). Additionally, this research will compare the Total Quality Management of the project when the BIM is utilized in the project and when it is not present. This will be achieved through performing investigations,

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utilization of assessment and evaluation tools, in addition to the approach of the comprehended results, while taking into consideration the leading aspects of the project represented in time and cost, which are incorporated to obtain the imperative quality.

II. LITERATURE REVIEW

Building In the building industry, one can look at the Building Information Modeling (BIM) methodology as an approach in applying Information Technology (IT) (Autodesk, 2003), which refers to analyzing, constructing, improving, executing, maintaining and administering computer-based information systems. Building Information Modeling (BIM) was first announced in 2003 by Autodesk as a modernly advanced technique in structure design, construction, and administration. Universally, this innovative technique was capable of altering the manner in which industrial experts contemplated on the influence of utilizing technology in structure design, construction, and administration (Autodesk, 2003).

With the presence of the BIM, the modeling and credentials of structure projects have witnessed the utilization of an innovative technique (Bentley, 2010). BIM, as a phrase, was initially devised in order to extricate the traditional CAD, which originally fixated on drawing fabrication, from the succeeding generation of IT and CAD for structures. Building Information Modeling (BIM) can be defined as the development and administration of structural data through an interoperable and sustainable manner. Consequently, BIM, is a system or an array of systems which allows operators to assimilate and salvage structural data and domain information within the structures life-cycle (Lee et al, 2006).

The Building Information Modeling (BIM) has been given various definitions. One definition for the BIM, which was given by the American Institute of Architects (AIA), claimed that the BIM was a "model-based machinery associated with a databank of project statistics" (AIA, 2010). Another definition was given by The National Building Information Model Standard (NBIMS), in which they considered the BIM to be an "automated interpretation of substantial and efficient aspects of an accommodation, as well as being a communal information source for data on an accommodation, creating a dependable foundation for evaluations during the accommodations life-cycle; which can also be defined as prevailing from the initial origin up to the destruction" (NBIMS, 2010).

Largescale, high profile projects have been manipulated with utilization of the BIM, of which includes the recently structured London 2012 Olympic 6,000 seating Velodrome cycle track and the 48 floors, 225 meters high, Leadenhall Building "The Cheese grater". Not only is BIM utilized in massive projects but also it can be administered within a smaller scale on specific components of projects. For instance, the BIM was utilized in the new bus post, which was opened in June 2011, at Slough, UK to model and install the modular stairs (Build offsite, 2011). As a result of the expected reimbursements from utilizing BIM with respect to the cut operation budgets and minimal error opportunities, the government of the UK settled that all contracts from the year 2014 and ahead will oblige that source chain associates to work cooperatively by manipulating the "fully collaborative 3D" BIM (Cabinet Office, 2011). The 3D BIM refers to all resource data, material and documentation for all projects to be in an automated manner. Moreover, the USA private and public sectors are working together in order to endorse the utilization of the BIM (Underwood and Isikdag, 2011).

Conversely, there have been assessments which state that the BIM case has not been completely proven where the total efficiency of utilizing BIM is utterly vindicated (Jung and Joo, 2010). The definition on BIM given by Succar stresses its all-inclusive complexion, that is composed of a software which not only incorporates arithmetical modelling and input of data but also project management (PM) associated utensils and procedures. Therefore, viewing of BIM in its all-inclusive nature definitely categorizes it in the structure PM domain. Additionally, BIM is capable of being utilized by structural project executives in order to enhance the association between the investors, where the time required for documentation is lessened, thus yielding advantageous project results. Moreover, of the BIM literature aspects, one involves specified documentation of BIM utilization on explicit project situations such as the Heathrow Terminal 5 (BSI, 2010) and the Walt Disney Concert Hall (Haymaker and Fischer, 2001).

III. ADVANTAGES OF BIM

BIM supports the continuous and immediate availability of project design scope, schedule, and cost information that is high quality, reliable, integrated, and fully coordinated. Among the many competitive advantages, it confers are (Autodesk, 2003):

1. Increased speed of delivery (time saved)
2. Better coordination (fewer errors)
3. Decreased costs (money saved)
4. Greater productivity
5. Higher-quality work
6. New revenue and business opportunities

IV. THE OBJECTIVE OF THE RESEARCH

1. Defining the importance of applying Building Information Modelling [BIM] in the implementation of construction projects to achieve quality control
2. Defining the mechanisms and methods that applying Building Information Modelling [BIM] in the implementation of construction projects to achieve quality control
3. Definition of Building Information Modelling [BIM] concepts and their practical applications.

V. THE PROBLEM OF THE STUDY

The nature of the this stage in the light of contemporary changes imposes new needs and capabilities that will ignite a productivity revolution which is based on the quality, speed, saving time, increased profits, saving effort, symmetry Planning to work in harmony in all operations and controlling chaos and random,

all these factors clarify the concept of using Building Information Modelling [BIM] for engineering construction projects in the quality industry.

The problems of engineering construction projects in Saudi Arabia are shown in, breaking a lot of projects during its implementation, the poor quality of project outputs or delivering the project after its due date and increased costs as an advance against profits, as a result of lack of understanding of the real management of the project and the lack of a comprehensive theory, which regulates the construction work (Abazid, 2017).

VI. RESEARCH METHODOLOGY

This research will be based on utilizing the descriptive analytical approach to achieve the objective of this study. In which 124 questionnaires were distributed to engineering firms and construction companies. To examine the data received from the questionnaires, the SPSS (statistical package for social science) program was applied.

VII. HYPOTHESIS

There is a statistically significant relationship between the non-application of BIM and lack of success of the application of quality concepts in the implementation of construction projects.

VIII. COMMUNITY RESEARCH SAMPLE

The research society includes engineering offices and contracting companies in Saudi Arabia, that are Specialists in various construction work.

IX. DATA MEASUREMENT

The questionnaire was constructed so that respondents were able to provide their rankings based on the Likert scale, which was deemed to be the proper method for analysis of the data. The ordinal scales, Likert scale, were based as shown in Table 1:

Table Likert scale.

Statement	Completely Agree	Mostly Agree	Slightly Agree	Mostly Disagree	Completely Disagree
Scale	5	4	3	2	1

X. DATA ANALYSIS AND DISCUSSION

A. Job of participants in the questionnaire

Table 2 shows that 55.6% of the sample are site engineer and the frequency is 14, 33.1% are site manager and the frequency is 42 and 11.3% of the sample are company manager and the frequency is 69.

Table 2: Frequency and Percentage of job of participants

Job	Frequency	Percent
Company manager	14	11.3
Site Manager	41	33.1
Site Engineer	69	55.6
Total	124	100.0

Figure 1 shows that 55.6% of the sample are site engineer, 33.1% are site manager and 11.3% of the sample are company manager so we conclude that the Percent of site engineer is the highest and the percent of site manager is higher than company manager.

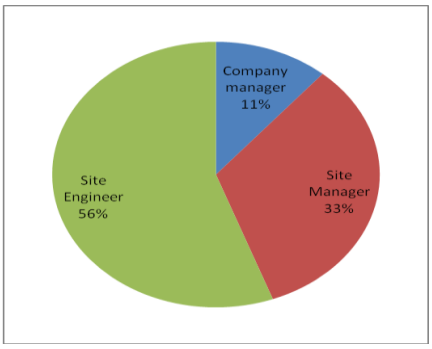

Figure 1: Percentage of job of participants tables.

B. Experience of participants in the questionnaire

Table 3 shows that 41.1% of the sample have experience "1-5 years" and the frequency is 51, 37.9% of the sample have experience "5-10 years" and the frequency is 47 and 21.0% of the sample have experience "more than 10 years" and the frequency is 26.

Table 3: Frequency and Percentage of experience of participants

Experience	Frequency	Percent
1-5 years	51	41.1
5-10 years	47	37.9
More than 10 years	26	21.0
Total	124	100.0

Figure 2 shows that 41.1% of the sample have experience "1-5 years", 37.9% of the sample have experience "5-10 years" and 21.0% of the sample have experience "more than 10 years".

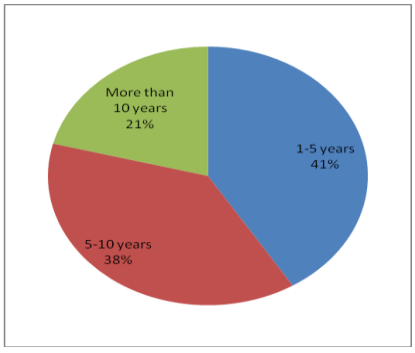

Figure 2: Percentage of experience of participants.

C. The Means and Test values for the Hypothesis

Table 4 shows the mean of the Hypothesis equals 2.89 (57.69%), Test value = -1.32, and p-value=0.095 which is more than the level of significance $\alpha = 0.05$. The mean of this field is insignificantly different from the hypothesized value 3. We found that the respondents (Do not know, neutral)

to field of " Non - application of BIM to achieve the quality concept ".

Table 4: Means and Test values for the Hypothesis

No	Question	Mean	Proportional	Rank
1	How do you evaluate management statistical control on the accuracy of BIM?	2.85	57.10	5
2	How would you evaluate a company's focus on achieving all standards of BIM?	2.84	56.77	6
3	How would you evaluate company's focus on achieving all standards of quality?	2.87	57.42	4
4	How would you evaluate management's efforts to inform the employees about the relationship between product's quality and BIM?	2.88	57.52	3
5	How do you evaluate the continuous improvement of the BIM system?	2.95	58.81	1
6	How would you evaluate the application of practical approaches to applied BIM?	2.94	58.71	2
	All items of the field	2.89	57.69	

Figure 3 shows the questions with the maximum mean is question 5 at 2.95, while question 2 has the minimum mean at 2.84. It also shows the mean of the Hypothesis is significantly less than the hypothesized value 3.

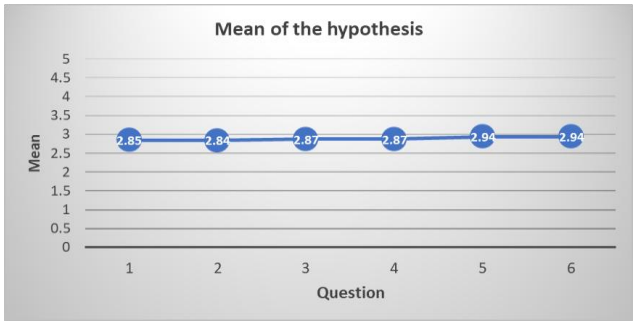

Figure 3: Mean of questions related to the hypothesis.

XI. CONCLUSION

The study shows that the majority of the respondents believe that there is a poor implementation of the Building Information Modeling (BIM) in the execution of the construction projects, which is considered as the most influential factor that causes the poor Total Quality Management in the construction projects in Saudi Arabia. Moreover, the study indicates that there is imperfection in the work of the administration in improving the activities of the quality system the companies and there is a weakness in setting procedures and approaches for achieving an effective observation in order to ensure that Building Information Modeling (BIM) is applied in the construction projects, which proves the main hypothesis that is there is Non - application of BIM to achieve the quality concepts in the construction projects.

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