Barriers in Adoption of BIM in Construction Industry of Pakistan

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***Abstract*: Building Information Modelling (BIM) is the new software-based technology that represents the development process and visualize the usage of n-dimensional models to simulate the planning, design, construction and operation of building in virtual environment. It is also used to identify conflicts in design, construction and operation of any construction projects. Construction industry is becoming complex day by day due to the less usage of information technology application tools in developing countries. BIM provides a lot of benefits to the players involved in construction such as saving of cost, reworking time, quick and earlier detection of clashes and errors. However, there are some barriers to implement BIM in the construction industry of Pakistan. The objective of this study is to identify the problems associated with the adoption of BIM in the construction industry of Pakistan. The Primary data were collected from literature review and the secondary data by questionnaire survey. SPSS 20 Software was used to interpret the data. The barriers identified were Lack of training skills, High cost of implementation, Legal and cultural issues, and In-appropriate government policies. The outcome of this study will help in enhancing the usage of BIM in construction industry of Pakistan.**

***Keywords*: Building Information Modelling (BIM), Barriers, Adoption, Construction Industry.**

I. INTRODUCTION

Building information modelling (BIM) is the new software based technique used throughout the AEC Industry. BIM is a complete 3Dimentional digital demonstration for system of building design, it covers both visual modeling of the building and a database to record the information developed and associated with the components of the building. BIM is not only a drawing and documentation tool but it provides a platform for multidisciplinary teamwork of the participants include in building design, capable to manage the changings in design and ability to extend the information support throughout the lifecycle of building [1]. BIM is the practice and process of design and construction of building in virtual environment throughout the building lifecycle [3]. Building Information Modeling (BIM) is one of the techniques that denotes the development procedure and usage of a software based produced model to simulate the planning, design, construction and operation of building in a virtual environment [2][4]. Building information modelling represents the real buildings in virtual environment over the whole building lifecycle [5].

II. LITERATURE REVIEW

Barriers in adoption of BIM

Despite from BIM tremendous benefits, it has also been regularly pointed by researchers like (Ashcraft & Esquire, 2007) and (Brewer & Gajendran, 2012) that BIM does come to its challenges.

Mazri yaakob conducted a research work to find the barriers for the implementation of building information modelling in the Construction industry of Malaysia. The identified barriers were grouped into six categories such as lack of training, high cost of implementation, lack of client demand, ownership issues, resistance to change and interoperability issues.

Javad Majrouhi Sardroud carried out a study to know the barriers for the implementation of BIM in the construction industry. BIM was considered as a new method which provides many opportunities and challenges to the AEC industry. The BIM implementation challenges were identified after a thorough review of 100 papers (out of these 47 papers were selected for this research work). According to the authors of these research papers the major issues regarding the implementation of BIM are Security issues (6%), financial issues (17%), legal issues (20%), cultural issues (27%) and finally management issues as largest by 30%. After analyzing these research papers it was concluded that UK is on the top in the implementation of BIM facing the most important and common cultural issues. It was concluded that from the above issues, security and contractual issues are the most serious issues. Due to these issues, the construction industry was considered as the less innovative as compared to the other industries.

George Kekana conducted to explore the ways to overcome the barriers that provide the hindrances in the adoption of BIM in the construction sector of South Africa. He identified the barriers for the adoption of BIM as lack of knowledge, skills and education, BIM standards, Design and professional responsibilities and Data intellectual property.

Caroline T. W. Chan investigated the barriers in the adoption BIM in the construction industry of Hong Kong. Several barriers to BIM adoption were identified, including lack of qualified in-house staff, lack of training/education, lack of standards and lack of client demand.

Shijing Liu carried out a research work to identify the barriers in adoption of BIM. The critical barriers identified were the high cost of application, lack of national standards, and lack of skilled personnel.

III. METHODOLOGY

A. Research Methodology

The Barriers in adoption of BIM in the construction industry were identified from the previous research work (Literature Review). Then, semi-structured interviews of the related experts were conducted to further identification of these problems. Finally a questionnaire survey was carried out to collect the data.

B. Questionnaire Survey and Data Collection

The questionnaire survey was used to collect the data. The questionnaire was prepared in two steps. In first step the questionnaire was prepared from the literature review in which barriers in adoption of BIM were identified. Then in second step, unstructured interviews were conducted from the related experts to check the reliability. The questionnaire consists of two parts: 1st part is related with personal information of respondents such as working position, years of experience using BIM, Type of industry etc. The 2nd part is related to the barriers in adoption of BIM in construction industry of Pakistan. The prepared questionnaire then floated in the field for the opinion of respondents. The questionnaire was distributed and collected through the internet sources such Google Forms and by personnel distribution and retrieval. A total 150 Questionnaires were distributed among the engineers, research/academia, architects, town planners, BIM Technicians, contractors and consultants. 132 questionnaires were returned back out of 150. Out of these 132 the respondents 76 were Engineers, 8 Architects, 8 Contractors, 11 Managers, 1 Owner, 2 BIM technicians, 2 Town planners and 24 from Research/Academia. Out of these 132 respondents, Hundred 100 copies of the questionnaires received using Google Forms, while thirty two 32 copies received in person.

C. Analysis Methods

The data was analyzed by different methods. The reason for having different methods for analysis is that the final conclusion will be strong. The SPSS 20 software was used to analyze the data. First part of questionnaire was analyzed by Pie charts and Bar charts. Because it is easy to evaluate the percentages and frequencies of each bar items. The second part of questionnaire was analyzed by Descriptive Statistics (Mean score and standard deviation) and Reliability Test.

Mean score and Standard deviation was used to examine each factor and rank in descending order as observed by the respondents in terms of their significant effect according to their group as well as to the overall section. In this method the mean score and standard deviation of all the factors were calculated and then ranked accordingly in descending order.

There are some factors which have same mean score obtained from the questionnaire survey. In order to differentiate between those factors in terms of ranking, standard deviation (SD) was used. The SD is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A standard deviation close to 0 indicates that the data points tend to be very close to the statistical mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

In order to check the homogeneity of the extracted factors, the reliability of internal consistency was tested using the internal consistency coefficient Cronbach's alpha (α). Where, Alpha (α) is depending on the averaged interaction among variables within each individual factor. (Yitmen 2011). In other means, Cronbach's alpha is the average score of each group Factor Loadings. The value of the alpha coefficient (α) ranges from 0 to 1, the higher the score, the greater reliability of the factor or the questionnaire is. Nunnaly (1978) has pointed out 0.6 is the minimum acceptable value.

IV. RESULTS

The data was analyzed using SPSS software version 20. The data is in two parts; the 1st part is related with personal information of respondents such as Working position, years of experience using BIM, public/private sector etc, the 2nd part is related to the barriers in adoption of BIM in construction industry of Pakistan.

A. First Part of Questionnaire (Personal information)

(i) Working Position

The responses received displayed respondents positions in their respective organizations shown in percentage in Figure 1. The respondents who filled the questionnaire were composed of 76 Engineers, 8 Architects, 8 Contractors, 11 Managers, 1 Owner, 2 BIM technicians, 2 Town planners and 24 from Research/Academia.

(ii) Experience

As shown in figure 02, 14 respondent haven't any experience, 74 respondents have an experience of 1-3 years, 19 respondents have an experience of 4-6 years, 13 respondents have an experience of 7-10 years and 12 respondents have an experience of 11 years and more.

(iii) Experience of Using BIM

As clearly shown in figure 03, 78 respondents haven't used BIM so far, 42 respondents have an experience of 1 to 3 years working with BIM technology, 10 respondents have an experience of 4 to 6 years working with BIM technology, 01 respondent has an experience of 7 to 10 years working with BIM technology and 01 respondents has an experience of more than 11 years working with BIM technology.

(iv) Organization sector

Figure 04 shows the results of the ownership of the organization or organization sector. From the collected data of respondents, 56 respondents are working with Public sector organizations, 74 respondents are working with Public organizations and 02 respondents haven't specified their organization sector.

B. Second Part of the Questionnaire (Barriers in adoption of BIM)

The second part of questionnaire is related with the Barriers in adoption of BIM in the construction industry of Pakistan. There were 20 barriers taken from the literature review explained by the different researchers in their research work. The Likert's scale (1 = Strongly disagree, 2= Disagree, 3 = Uncertain, 4 = Agree and 5 = Strongly Agree) was used to rank these barriers. The data collected from these 132 respondents were analyzed by calculating their Mean and Standard Deviation values. Then these Barriers were ranked in the Descending order of Mean value means the barrier having highest Mean value will be at top. The table 02 shows the Mean score and Standard deviation of all the factors.

Reliability Test

The Cronbach's alpha value is calculated to check the reliability of the results obtained from the respondents. The collective alpha value is calculated for all the barrier in adoption of BIM. The Cronbach's alpha value of the collected data from respondents is **0.750** which is in between the acceptable range of 0.6 to 0.9.

V. CONCLUSIONS

It was concluded that there are some barriers in adoption of BIM in construction industry of Pakistan and the top barriers are Lack of training and skills, Lack of BIM Manager, Lack of knowledge to project stakeholders, Lack of knowledge and experience to contractors and sub-contractors, Resistance to adoption of change, Lack of specified standards and In-appropriate government policies.

VI. FIGURES AND TABLES

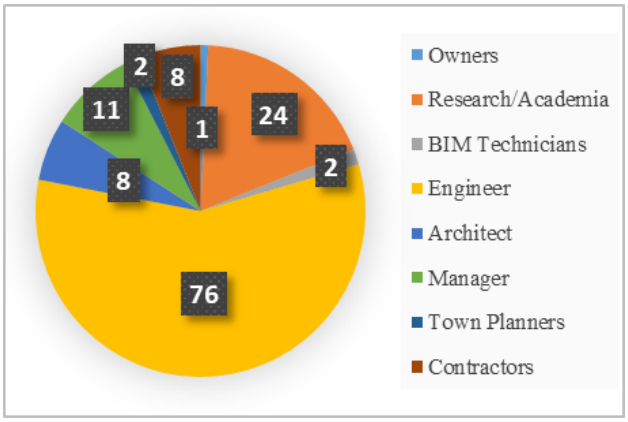

Fig 01: Working position

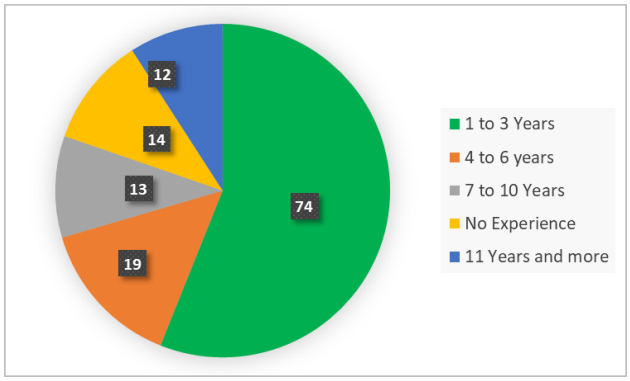

Fig 02: Experience of responses

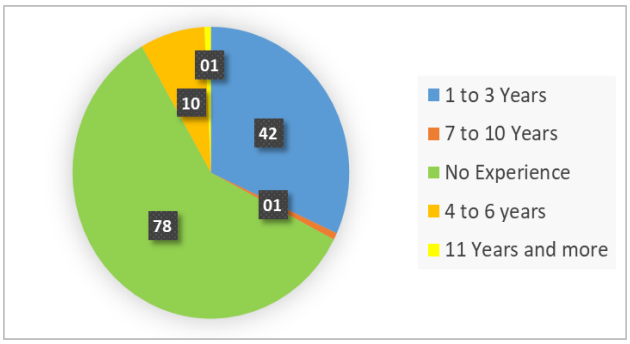

Fig 03: Experience of using BIM

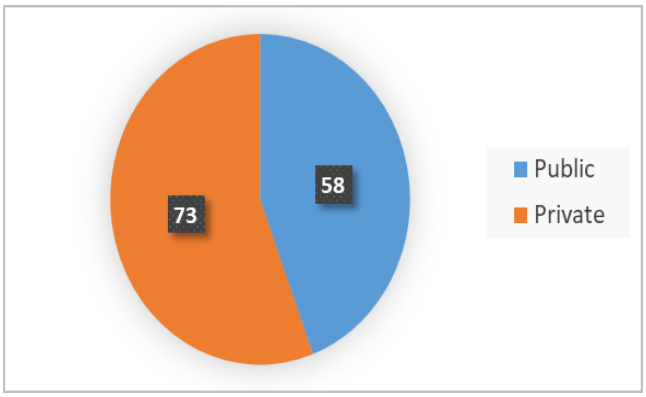

Figure 04: Organization Sector

Table 01: Mean score and Standard deviation of Barriers in adoption of BIM

Sr No	Barriers in Adoption of BIM	Mean	Standard deviation
1	Lack of training and skills	4.33	0.833
2	Lack of BIM Manager	4.02	0.866
3	Lack of knowledge to project stakeholders	3.99	0.937
4	Corruption People Resistance as BIM provides Transparency	3.99	0.920
5	Lack of knowledge and experience to contractors and sub-contractors	3.92	1.143
6	Resistance to adoption of change	3.88	1.004
7	Lack of specified standards	3.86	0.979
8	In-appropriate government policies	3.85	1.015
9	Resistance to changes in employment patterns	3.85	0.833
10	Unclear BIM advantages regarding growing practices.	3.81	0.966
11	Collaboration issues at Pre-construction stage	3.79	0.892

12	Lack of demand for use and acceptance of BIM	3.73	1.133
13	Data and intellectual property issues	3.73	1.012
14	Interoperability issues at construction stage	3.68	0.894
15	Reluctance of Clients/Contractors	3.67	1.039
16	Organizational Issues	3.62	1.077
17	High cost of implementation	3.44	0.983
18	High cost of BIM software	3.32	1.086
19	Cultural issues	3.12	1.264
20	Legal issues	3.06	1.162

Table 02: Reliability test of Barriers in adoption of BM

Reliability Statistics

Cronbach's Alpha	No of Items
.750	20

REFERENCES

[1]. Louise Sabol. “Building Information Modeling & Facility Management” IFMA World Workplace, November 2008.
[2]. N Kasim et al. “Best practices of Building Information Modelling (BIM) implementation in design phase for construction project” IOP Conf. Series:
[3]. Materials Science and Engineering 271 012038 (2017)
[4]. Masood et al. “Is BIM Adoption Advantageous for Construction Industry of Pakistan?” Procedia Engineering 77(2014) 229 – 238.
[5]. Azhar, S. et al “Building Information Modelling (BIM): Trends, benefits, risks, and challenges for AEC industry”. Leadership and Management in Engineering. 241-252 (2011).
[6]. Volk, R.; Stengel, J.; Schultmann, F.: Building Information Models (BIM) for existing buildings – literature review and future needs - Automation in Construction 38, pp.109-127, DOI: 10.1016/j.autcon.2013.10.023 (2014).
[7]. David Bryde et al. “The project benefits of Building information modelling” International Journal of Management 31 page 971-980 (2013)
[8]. Z. A. Memon et al. “The Use of Inforamtion Technology Techniques in the Construction Industry of Pakistan,” Mehran University Research Journal of Engineering & Technoogy vol. 31, no. 02, 2012.
[9]. Yan Liu et al. “Understanding the effects of BIM on collaborative design and construction” An empirical case study of China. International Journal of Management 35 page 686-698 (2017).
[10]. Amala Merlin Jose et al. “Application of Building Information Modelling (BIM) in Construction Planning Process” International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 04 Apr-2018.
[11]. Mazri Yaakob et al. “A Study on Benefits and Barriers of Implementing Building Information Modelling (BIM) in Malaysian Construction Industry” Proceedings of the International Conference on Industrial Engineering and Operations Management Paris, France, July 26-27, 2018.
[12]. Javad Majrouhi Sardroud et al. “Barriers Analysis to Effective Implementation of BIM in the Construction Industry” 35th International Symposium on Automation and Robotics in Construction (ISARC 2018).
[13]. Wadhah A. Hatem et al. “Barriers of Adoption Building Information Modeling (BIM) in Construction Projects of Iraq” Engineering Journal Volume 22 Issue 2, 30 March 2018.
[14]. George Kekana et al. “Overcoming barriers that hinders the adoption and implementation of building information modelling in the South African construction industry”
[15]. Hussein M Hamadaa et al. “Benefits and Barriers of BIM Adoption in the Iraqi Construction Firms” International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2763, Issue 08, Volume 3 (August 2016)
[16]. Kekana T.G. et al “Barriers in Adoption and Implementation Strategies in the South Africa Construction Industry” International Conference on Emerging Trends in Computer and Image Processing (ICETCIP'2014) Dec. 15-16, 2014 Pattaya (Thailand).
[17]. Caroline T. W. Chan. “Barriers of Implementing BIM in Construction Industry from the Designers’ Perspective: A Hong Kong Experience” ISSN 1816-6075 (Print), 1818-0523 (Online) Journal of System and Management Sciences Vol. 4 (2014) No. 2.
[18]. Shijing Liu et al. “Critical Barriers to BIM Implementation in the AEC Industry” International Journal of Marketing Studies; Vol. 7, No. 6; 2015 ISSN 1918-719X E-ISSN 1918-7203 Published by Canadian Center of Science and Education.