

Implementation of Building Information Modeling (BIM) in Pakistan Construction Industry

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Abstract—This paper examines the implementation of building information modeling (BIM) in construction industry. Various initiatives and approaches are used in different countries to promote the BIM implementation in their construction industries. The real implementation and use of BIM remains a major concern of the construction industry. This study investigates the implantation of BIM globally, in developed countries and the percentage of implementation of BIM in construction industry of Sindh, Pakistan. This research demonstrates 131 responses from BIM users regarding BIM implementation whose collaboration aspects produce the highest positive impact. The adopted methodology is an online questionnaire survey and literature review which was conducted to find out the implementation of BIM in construction industries of developed countries. This research reveals that BIM implementation is increasing continuously over the past few years. A Number of developed countries are emerging successful BIM implementation strategies, United States, United Kingdom, Germany, France are generally leading the way. However, according to our study findings, only 11% of industries have implemented BIM in Sindh, Pakistan.

Keywords—building information modeling; implementation; construction industry; developed & developing countries

I. INTRODUCTION

Building information modeling (BIM) is a new innovative technology. The use of BIM technology is not limited only to the design of 3D models, but it can be used for detailed design and analysis, to create project documentation, to prepare estimates and to monitor the progress for ongoing project until completion [1]. Except that, BIM can be used for operation, maintenance and demolition of existing projects. BIM technology is used as a three-dimensional 3D model-based process which provides architecture, engineering and

construction (AEC) professionals with more efficient planning, design, construction and management of buildings and infrastructure projects [2]. BIM can be viewed as a virtual process that encompasses all aspects, disciplines, and systems of a facility within a single virtual model, allowing all design team members (owners, architects, engineers, contractors, subcontractors, and suppliers) to collaborate more accurately and efficiently than using traditional processes [3, 4]. BIM also facilitates us to enhance decision making and implementation throughout the life cycle of a project [5-6]. Previously most of design decisions were taken by experts who were designing the project according to client specifications and requirements because the client himself or other technical people could not take decisions on their behalf. But in modern days, BIM technology has brought all stakeholders to one platform where they can contribute from the initial design process to the end of the project. The implementation of BIM is a problem for developed and developing countries, whereas in developed countries their government, technical organizations and institutions are performing great role to implement BIM technology and it has been found that they have succeeded to a certain level. The implementation of BIM is a chronic concern for developing countries like, Malaysia, Sri Lanka, India, Pakistan etc. This research is limited for Sindh, Pakistan. The primary objective of this study is to identify the percentage of BIM implementation in Pakistan construction industry.

BIM as an official term was used in 1992 and later on in a 2000 software called “Revit Software”. After that the same software was sold to Autodesk and they brought many new changes in 2004. Currently that software is known as Autodesk Revit. BIM has brought revolutionary change in the field of building design to some high level of extent [2]. According to [7] BIM provides a platform to work with collaboration. In

BIM, a single project can be subdivided into different phases because in a single project there is involvement of different experts of various fields depending upon the nature and type of project. They accumulate their work together into a single project. Therefore, different experts in various fields using BIM software don't have worry about the design process because integration and coordination will be done by the system automatically. A wide research is ongoing to realize the issues for BIM implementation in construction industry [8-10] and to communicate the advantages of real BIM implementation to construction industry [11-12]. Authors in [13] have been tracking the evolution and implementation of BIM in global construction industry. They report that BIM implementation was 26% in 2007 and over doubled in less than a decade, reaching 57% in 2016. BIM is widely used in United States, United Kingdom and Western Europe. Familiarity of BIM spread out among developed and developing countries and, after 2007, the ratio of BIM users increases. Increasing ratio of BIM usage is considerably higher in developed countries rather than in developing countries. In North America a survey was carried out regarding BIM implementation in construction industry. In 2008 it was recorded that only 28% of construction companies were using BIM, but when construction industry got familiar with the advantages of BIM, the escalation reached to 72% in 2012. Authors in [13] predicted that this will continue to escalate, with BIM market from 1.8 billion USD in 2012 to reach 6.5 billion USD by 2020. Sudden increase in number of BIM projects is anticipated over the next 18 months transforming well beyond the achievement to date. Authors in [13] carried out a survey and collected responses of 727 contractors from developed and developing countries regarding BIM implementation in the top ten of the largest national construction markets in the world. United States, United Kingdom, Germany, Malaysia, France, Australia, Canada, India, Singapore, Sri Lanka and Middle East had been reviewed as described below.

A. United States

A significant number of construction companies in US believe that BIM has a potential to reduce the cost of the projects. This is the reason why 72% of companies are using it.

B. United Kingdom

According to [15] BIM implementation in UK had reached 54%, whereas in 2015 it was 48%. Since April 2016, the government has issued a strategy for construction companies, which aims to achieve 20% savings in procurement cost.

C. Germany

BIM implementation in Germany has reached up to 90% [14]. Most of the construction companies and clients are aware about BIM technology so there is a demand for it.

D. Malaysia

Only 20% of the architectural firms are implementing BIM while 10% of surveying firms are using it [11, 16, 17].

E. France

In 2014 the government of France decided to develop 500,000 houses in 2017 by using BIM for that project [18].

They digitized the building industry by investing 20 million euros. Today 65% of construction companies are using BIM aiming to achieve sustainability and reduced costs [18].

F. Australia

A research was carried out through a series of interviews with 25 construction companies from two major cities in the state of Queensland. They found that 51% of companies use BIM [19].

G. Canada

Canada has founded various organizations to adopt and implement BIM, like Canada BIM council, Institute for BIM in Canada and Building Smart Canada. This is the reason why the ratio of implementing BIM has reached 67% and still keeps on increasing.

H. India

BIM adoption in India is very low compared to other countries. According to research, it is found that only 22% construction companies are using BIM. In India BIM is also known as virtual design and construction (VCD) [20].

I. Singapore

BIM has transformed the construction industry. Singapore BIM implementation rate is rising rapidly [21].

J. Middle East

According to [22] BIM is implemented by 10% of construction companies on their projects.

II. BENEFITS OF USING BIM

Based on the survey responses and interviews conducted in previous studies, it is found that BIM has potential and must be deployed in construction industry. Most respondents have significantly reduced cost and time with the use of BIM [24], some professionals using BIM reported that it helps improve coordination among different stakeholders, such as architects, contractors, suppliers and other project team members. Publications, researches and policies have been developed to implement BIM. The governments of US, UK, Germany, Canada and other developed countries have made the implementation of BIM compulsory in their industries [24]. In UK and Canada there's a high level of BIM awareness because UK government has invested on their professionals to be trained in BIM technology, whereas a number of institutions launched by Canadian government are specialized to aware professionals about BIM, while European countries like Finland, Denmark, Norway and Sweden are known as BIM leaders [25].

III. METHODOLOGY

Based on the collected information, an online questionnaire was developed and distributed for collecting data regarding the practical implementation of BIM in construction industry of Sindh, Pakistan from targeted participants. The link to the questionnaire survey was sent to contracting companies, consultant and architectural firms and engineers. The firms' email addresses were obtained from their websites, whereas the engineers were contacted through social networks. The

questionnaire was consisting of personal information and just only 11 questions regarded the BIM evaluation. The combined sample size of the study is summarized in Table I.

TABLE I. CONSTRUCTION CONTRIBUTOR

| Types of Contributors | Questionnaires distributed |
|-----------------------------------|----------------------------|
| Contracting Companies | 50 |
| Consultant & Architecture | 50 |
| Engineers (1-5 years' experience) | 100 |

IV. SURVEY QUESTIONNAIRE

The questionnaire consisted of two sections, section A inquiring the demographics of the respondents while section B was related to BIM in construction industry of Pakistan. The survey questionnaire is depicted in the appendix.

V. RESULTS AND DISCUSSION

A. Survey Analysis

The questionnaire survey respondents were contracting companies, consultant and architectural firms and engineers. The response rate from contracting companies was 58%, from consultant and architectural firms 62% and from engineers 71%. All the companies were of medium size having 1-100 employees and all engineers had 3-5 years of experience. The survey analysis is shown in Table II.

TABLE II. SURVEY RESULTS

| Survey Analysis | | | |
|----------------------------------|-------------|--------------|--------------------|
| Respondents | Sample Size | Respond Rate | Respond Percentage |
| Contracting Companies | 50 | 29 | 58% |
| Consultant & Architectural Firms | 50 | 31 | 62% |
| Engineers | 100 | 71 | 71% |

B. Response Analysis

1) Contracting Companies

Questionnaires were distributed among 50 contracting companies and only 29 of them responded. When their responses were further analyzed, 4 companies were using Revit Architecture software which is a BIM application to generate only 3D geometrical models, 11 companies had known BIM but were not implementing it and 14 companies were unaware about BIM. This shows that only 8% of contracting companies were using a BIM application which is a very limited and initial stage of BIM, and only to generate 3D geometrical models.

2) Consultant and Architectural Companies

Questionnaires were distributed among 50 companies and only 31 companies responded. Only 7 companies were using a BIM application to generate 3D geometrical models for architectural and MEP services, their percentage being 14% which only shows that these firms are also using BIM to a very limited level. 24 companies were familiar to BIM but they were using other applications to generate 3D models.

3) Engineers

Questionnaires were distributed among 100 engineers and 71 of them responded. Only 11 engineers were familiar with BIM and their knowledge of BIM applications was focused only in 3D geometric model generation. The rest of the engineers were not familiar with BIM.

VI. CONCLUSION

BIM has altered the way of designing, constructing and operating buildings. BIM utilization led to augmented profitability, reduced cost, reduced project duration and enhanced customer-client relationships. Implementation of BIM has progressed rapidly. In a global scale, in 2007 it was 26% and in 2016 it reached 57%. BIM implementation is an enduring problem in developing countries. In Pakistan only 11% of related industry has implemented BIM and only to generate 3D models which is a very limited part of BIM.

APPENDIX

The survey questionnaire which was distributed among the respondents, section-wise follows.

Section A: Demographics

- Name and address of company / organization
- Type of your Organization
 - Consultant
 - Client
 - Contractor
 - Other (please specify)
- Type of building project undertaken by your company
 - Residential Building
 - Non-Residential Building
 - Others (please specify)
- The size of projects you have involved in terms of contract amount:
 - 0-50 million PKR
 - 51-100 million PKR
 - 101-500 million PKR
 - Above 500 million PKR
- Level of your Academic Qualification
 - Diploma
 - Masters
 - Bachelors
 - Ph.D
- Years of working Experience in Construction Industry
 - 0-5 years
 - 11-15 Years
 - 21-25 Years
 - 6-10 years
 - 16-20 Years
 - More than 25 Years
- Current Position in the Organization
 - Engineer
 - Planner
 - Quantity Surveyor
 - Contracts Manager
 - Construction Manager
 - Project Manager
 - Resident Engineer
 - General Manager

Section B: Implementation of BIM in Construction Industry of Pakistan

- Are you aware of BIM and its benefits?
 - Yes
 - No
- Is your company aware of BIM and its uses?
 - Yes
 - No
- Does your company use any BIM Software?
 - Yes
 - No
- Which BIM software is used in your company/Organization if any?
 - Revit (Arch, Struct, MEP)
 - Vectorworks Architect
 - ArchiCAD
 - MicroStation
- Do you believe that industry is not yet clear enough of what BIM actually is?
 - Yes
 - No

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