

Awareness and Adoption of BIM in Construction Industry

Abuzar Aftab Shaikh, Ramya Raju, Nida L. Malim, Dr. (Mrs.) Geetha K. Jayaraj

Department of Civil Engineering,
Shivajirao S. Jondhle College of Engineering and Technology
Asangaon, Thane, Maharashtra India
abuzarshaikh101@gmail.com
r_ranju1991@yahoo.com
nidamalim1990@gmail.com
jayaraj.geetha@gmail.com

Abstract: Building Information Modeling is a new technology use to support business process, currently BIM is used by professionals worldwide on all building types. The adoption of Building Information Modeling (BIM) has enhanced the construction industry by means of increasing quality of project, accurate quantity take-off, improved planning, scheduling, and visualization, consequently diminishing project contingencies, time and cost. BIM has been adopted by several countries, many researchers and institute have attempted to measure the BIM status across the world for which many quantitative and qualitative surveys have been conducted. The implementation of BIM technology is by no means equal in different countries all over the world. This study involves finding the awareness and adoption of BIM in the city of Mumbai among the construction professionals like Builders, Contractors, Site Engineers, Design Engineers and among the professors and students of different Civil Engineering Colleges under University of Mumbai for which a quantitative and qualitative questionnaire survey was conducted, total 441 responses were collected and the data was analyzed, it was found that total awareness among the respondent who are aware of BIM is 52 percent out of which the awareness among the civil engineering professors is at the highest i.e. 37.18 percent and among the students the awareness about building information modeling is low about 8.40 percent.

Keywords: *Building Information Modeling (BIM), Mumbai, awareness, Questionnaire survey.*

I. INTRODUCTION

Building data displaying is an incorporated insightful 3D model which is associated with information, procedures and assets between a few phases of undertaking life cycle. The national building data model characterizes Building Information demonstrating as "a computerized representation of physical and utilitarian qualities of an office and it serves as a mutual learning asset for data around an office shaping a dependable premise for choices amid its life cycle from initiation onwards"[1]. Building Information Modeling has been a developing improvement inside the previous couple of years in the development business [2], this is because of its ability on development ventures. The utilization of BIM has given a way to expanding all out undertaking quality, giving precise booking timetables, yielding amount take-offs and decreasing aggregate task cost [3] by its capacity to encourage joint efforts among a few orders. The idea of BIM hypothetically rose and was created at Georgia Institute of Technology in the late 1970's and became quickly after that and was initially utilized as a part of 2002 to portray virtual configuration, development and office administration [4]. As per National Institute of Standard report 2004, the capital offices development industry waste \$15.8 billion (₹ 948 billion) every year because of interoperability wastefulness [5] which causes the passage and amusement of data and information which can be overcome by utilizing BIM [6] and empowers plan data to be made unequivocal, so that its aim and program can be in a split second comprehended and assessed [7], this can bring about an expansion in the rate and

precision of transmitted data, lessening of costs connected with an absence of interoperability, computerization of checking, examination, the backing of operation and support of exercises [8].

Development commercial ventures are advancing themselves from 2D attracting to 3D model and from Gantt outlines, Network investigation to venture organizer programming but then they keep on evolving by presenting to all the essential parts of development at single stage by creating a virtual clever model called Building Information Modeling (BIM). BIM when incorporated with time plan gets to be 4D model and when it is connected with expense gets to be 5D model and this can go up to "nD" where "n" will be the important part of development.

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II. LITERATURE REVIEW

The Architecture, Engineering and Construction (AEC) industry is one of the biggest business on the planet and second biggest in India. The development business includes expansive number of complex tasks which needs to experience an assortment of difficulties [9]. Development industry is of incredible significance being developed of Infrastructure and extensive measure of capital is contributed each year. As indicated by U.S Census Bureau New 2013 evaluated that the development business would spend more than \$874 billion dollar in 2013 [10], in India roughly 50% of the five year arrangement spending plan is put resources into various stream of foundation, In Twelfth Five year arrangement (2012-2017) the anticipated spending plan for base is about ₹ 55,74,692 crore [11], since gigantic capital is contributed we require a framework which empowers to accomplish the sought undertaking objective and BIM offers the possibility to accomplish these. BIM is upsetting the method for development in Industries the adaption of 4D demonstrating gives scheduler, organizer and undertaking administrator a remarkable device to take care of the issue that may emerge amid the development stage [12].

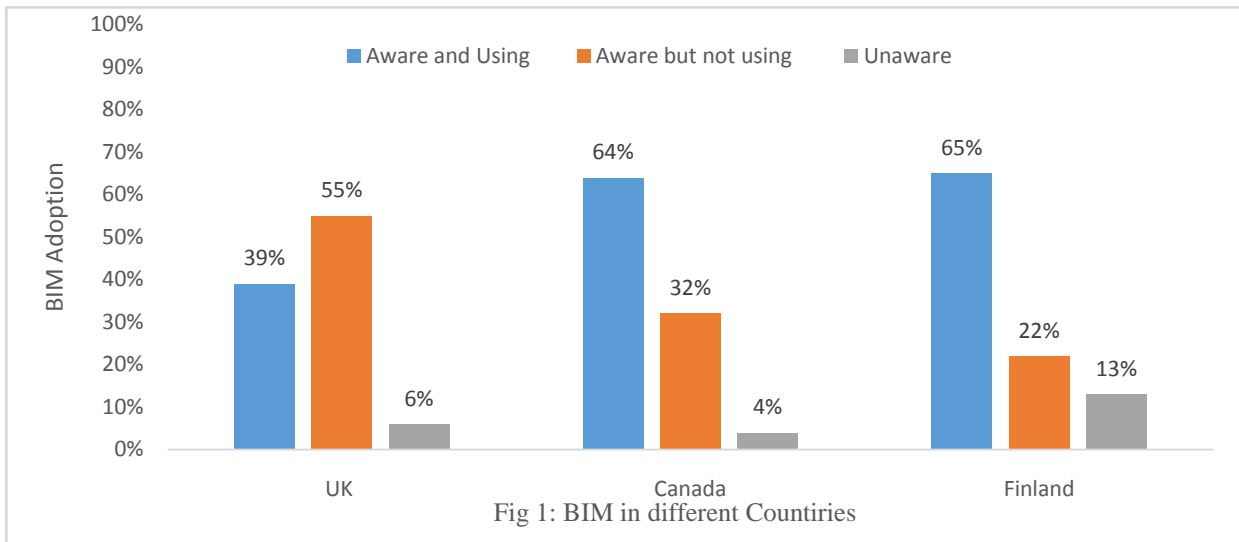
a) Status of BIM

BIM is a new technology hence there is a huge variation in BIM usage and adoption in different countries. In some countries this concept has been introduced years ago and many others are just starting to get on board. Wang and Chien conducted a quantitative and qualitative questionnaire survey to find out the awareness of BIM in Australian industry, it was

found that 39 percent of the total respondent are aware and using BIM in the respective construction firm, 41 percent are aware of BIM but not using BIM, and 20 percent have not heard what BIM is? [13]. Survey conducted by Smart Market Report shows that the rate of BIM adoption and level of experience in North America has increased from 28 percent in 2007 to 49 percent in 2009 and up to 71 percent in 2012 [14], BIM is growing rapidly in New Zealand, it has shown steep increase from 34 percent in 2012 to 57 percent 2013 and unawareness has declined from 12 percent in 2012 to 2 percent in 2013. Construction Market in the Middle East is at large number hence new technology will provide additional benefits to company, for which a survey was conducted to find out the awareness and operations of BIM in Middle East, the States in the Middle East chosen for survey were UAE, Saudi Arabia, Qatar, Oman, Bahrain, Kuwait and Jordan. There was a noticeable concentration of respondents operating BIM in UAE are (77%), Saudi Arabia (41%) and Qatar (35%), with Oman, Bahrain, and Kuwait, being 22%, 19% and 18% respectively. Jordan had the lowest accounting for only 7% of respondents. Similarly many countries like United Kingdom (UK), Canada, and Finland [15], [16]. Country like India has shown very less interest in adopting BIM over the past year, survey conducted by Indian built environment sector, RICS school of built environment and KPMG found that 22 percent of respondent are currently using BIM, 27 percent reported that they are aware of BIM and thinking to adopt, 43 percent of respondent claimed that they are just aware and 8 percent are unaware of BIM [17], Smart Market Report published in their blog that according to a report by Autodesk, International firm using BIM in India with construction market valued at \$140 billion (₹ 840 billion) in 2014 and the forecasted growth of BIM in Indian construction market will be \$620 billion (₹ 37,200/- billion) by 2020 [18]. Kumar and Mukharjee reported, the disciplines in which BIM is adopted are Architecture 92 percent, Engineering 43 percent, Construction 38 percent, Construction Management 40 percent, Pre-project Planning 36 percent, Structural Steel designer and fabricators 22 percent, MEP Sub-Contractor 15 percent, Owners 6 percent, and others 13 percent and the mostly used software among all the BIM software is Autodesk Revit with 64 percent of BIM users are using in their respective firm [19]. BIM now a day has become standard for Project Management.

b) Interoperability of BIM

Interoperability is the ability to exchange information between two or more systems or elements and to use the information that has been exchanged". Interoperability is essential because there is no software or tool which can independently do all the tasks associated with the building, design and production. Interoperability issue is gaining attention with increased use of BIM. In addition to using BIM to create 3D design, these models are a rich database of the physical and function characteristics of a facility. In order to optimize the use of BIM, it is critical that much of this BIM data be shared between build team members. As a result, interoperability of technology



is an important factor, Re-entering data from a BIM into another application or platform used by the build team creates wasteful and costly duplication. The National Institute of Standards and Technology set-off alarms about the issue in 2004, estimating that lack of interoperability costs U.S. capital facilities market \$15.6 billion per year and on a global basis it would be more than \$ 60 billion, the study estimated that between 0.86 percent to 1.25 percent of construction spending is directly related to inadequate interoperability [20]. The format available for exchanging and communicating Building Information Model are, Industry Foundation Class (IFC), Application Programming Interface (API), Extensible Markup Language (XML), Design Web Format (DWF), Open Database Connectivity (ODBC), Drawing (DWG), Drawing Exchange Format (DXF) and Portable Document Format (PDF) [21].

c) Application of BIM

Building Information Modeling has very vast application from AEC industry to MEP process; it has some specific features that can effectively be used in project Management.

1. Conflict resolution and clash detection

One of the common problems of different disciplines plan for a construction project is the geometrical design inconsistencies [10]. BIM allows the user to identify the element in 3D which interfere with each other or occupy same space. BIM clash detection is an intelligent system and it combines geometry clash detection with semantic and rule based clash detection [21] for resolving the conflicts.

2. Quantity take-off and cost estimation (5D)

Quantity take-off with BIM provide consistent information less prone to human errors [21] and can be very helpful for the project teams and managers to analyze their decision and have a clear and reliable insight to various alternatives in the design phase or even throughout the project life cycle [10] thus helps estimators by giving more time to optimize prices from Sub-Contractor and Suppliers [21].

3. Visualization

Visualization of the project before the construction starts is an effective way of streamlining the preplanning of the projects. It helps in identifying the problems that may arise during the construction phase by facilitating collaboration and coordination amongst the project team members [21].

4. Time (4D)

4D (3D+time) BIM requires linking construction plan to the 3D model, which makes possible to visualize how the building and site would look like at any point in time by simulating the construction process. 4D tools allow planners to visually communicate and plan activities in the context of time and space [3].

There are many other BIM application in various fields such as Constructability, Facilities Management, Fabrication, Energy Analysis, Collaboration and Team Building, Communication, Integration etc. [10], [21].

III. METHODOLOGY

Building Information Modeling is a new technology recently introduced in India, hence an effort was made to find out the awareness of BIM and its application in construction industry and project management, among the construction professionals such as Contractors, Builders, Site Engineers, Design Engineers, Project Managers, Professors and Students of civil Engineering colleges by conducting a quantitative and qualitative survey for which 27 questions were drafted covering major aspects of BIM. The Mumbai city is adopted for the study as it is in one of the most popular and fast growing cities, many multi-national companies like Larson & Tubro, Lafarge, Lodha groups, Billimoria, Capacite, Interarch Infrastructure India etc. are running their projects in Mumbai. The questionnaire was prepared in Google Doc and in Hard copy and was distributed among 10 builders, 10 contractors, 10 project managers, 50 site engineers, 50 design engineers, professors and final year students of 16 civil

engineering colleges which come under University of Mumbai, affiliated by AICTE. The survey data was collected by personally visiting the respective individual and colleges or with the help of reliable sources and to whom it was not possible to visit, the survey data was collected through Google doc, linking with the mail i.e. one mail one response only, total 441 responses were collected and analyzed.

IV. DATA ANALYSIS

The survey data was analyzed and it was found that 52 percent of the respondents are aware of BIM out of which only 4 percent are using BIM in their respective projects for visualization. 48 percentages of the respondents have not heard about BIM. The breakdowns of awareness among the respondents are as follow:

Table I: Awareness of BIM among different Parties involved in Construction

Sr. No	Respondents	Response percentage (%) within same category	Overall response percentage
1	Builders	20	0.453
2	Contractors	20	0.453
3	Project Managers	60	1.4
4	Site Engineer/ Design Engineer	34	3.85
5	Professors	81.5	37.18
6	Students	23.125	8.40

Among all the respondents the awareness in professors is at higher level of 37.18 but they only have an idea about what BIM actually is. They have never worked on BIM. Awareness in the students is about 8.40 percent only. During the survey suggestions of each individual were taken. Most of the

Table III: Benefits and Barriers of BIM adoption

Sr. No	Description	Agreed	Disagreed	Unknown
A	Benefits			
1	Clash Detection and conflict resolution	54.94	8.33	34.72
2	Coordination between Construction Phase	44.28	10	45.72
3	Improves productivity and quantity take-off	56.72	9.47	33.78
4	Increases the speed of project delivery	58.89	12.32	27.39
5	Reduces the overall project duration	41.09	24.65	34.24
6	Reduces overall project cost	45.33	20	34.67
B	Barriers			
1	Lacking due to non-expert staff	52.77	12.5	34.7
2	Barrier to BIM adoption is due to high cost and its timely update	57.33	2.73	38.35
3	Lacking due to exchange and interoperability	38.02	16.90	46.47

respondents suggested that a seminar and workshops should be organized in each in every college or at some specific location through which awareness can be made possible in the construction professionals and students. Among all the response data it was found that the awareness of the software which can be used for BIM process is given below:

Table II: Awareness of BIM tool

Sr. No	Software	Percentage awareness
1	Autodesk Revit	37.33
2	Autodesk Naviswork Manage	22.67
3	Tekla Structures	18.67
4	Bentley (Arch, Structure, Mech, Elec)	6.667
5	Autodesk BIM360 Glue	6.667

8 percent of the respondents have not heard about any software, from the above mention statistics only 1.33 percent of the respondents are using Autodesk Revit in their projects.

V. CONCLUSION

The conclusion drawn from the survey was based on the benefits of BIM and Barriers in BIM adoption. The results are shown in Table 3. Through survey data it was found that the awareness of BIM is high among the professors but low among the construction professionals in the city of Mumbai, in the survey data sheet a provision was made for suggestions. Many of the people who know or who don't know about BIM have shown their interest in learning the BIM technology as they believed that it will be a future of project management. Students and professors have shown their interest in including it in their curriculum as a part of study and conducting workshops, expert lectures to make people aware of Building Information Modeling.

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