

# BIM Used In Architecture, Engineering & Construction (AEC) Industry

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**Abstract** - BIM is assisting project managers in increase communication and providing a platform for stakeholders to collaborate and manage their projects, which lead to greater efficiency and success rate of the AEC industry. BIM creates an opportunity in building sectors to make a prototype for forecasting the construction stages. However, in real world application, project managers face challenges and barriers with BIM implementation into their processes. This research paper intends to highlight the main characteristics of the BIM, its advantages, challenges and risk management capabilities to elaborate on possibility of implementing BIM in AEC industry in India. Research points towards a slow pace at which BIM is adapted in India. Findings of this research show that project managers face two prime challenges: lack of knowledge of BIM software while implementing BIM into their project & lack of knowledge of project management role shifts post implementation. The aim of this research paper is to demonstrate a clear view to manage a construction project in construction phase through BIM process. To make this paper, resources referred are BIM software and construction management study experience, publications, AEC journals, articles, online magazines and practical experience based books and related topics.

**Keywords** — *Anticipated, BIM, construction management, entity, forecast, MIS, Stakeholders.*

## I. INTRODUCTION

Currently, a lot of construction projects are suffering from inefficiency in terms of documentation, validation of information, documenting procurement of inventory, inefficient labor productivity and poor management of information. These are criteria that can cause financial loss to any Architectural, Engineering and Construction (AEC) project. Demographic data of Indian population states that over 65% of population is under the age of 35 years and almost 60% of population of India is under age the of 25 years. This indicates that, our country has youth which can contribute to dynamic growth of construction industry in our country. Any financial loss on such project will result in project managers to fail delivering a successful project. The advancement of new Information Technologies (IT) in the recent decades has impacted AEC industry's projects immensely across the globe. These new tools are not just simply a software or technology, but they are affecting the project management processes by impacting the efficiency of the process and by altering the traditional roles of project management process.

## II. LITERATURE REVIEW

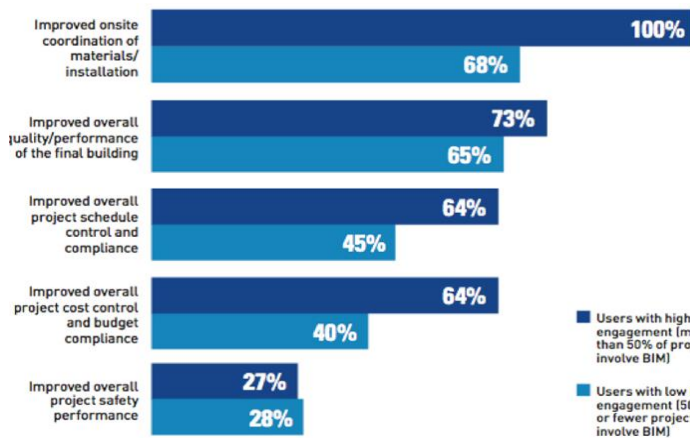
The literature review focuses on establishing a theoretical understanding of BIM and the barriers limiting its adoption and secondly to be a comparison for the empirical data. The areas of interest for my literature review are: advantages of BIM and barriers to BIM adaptation. The sources have mainly been books and articles. McGraw Hill (2014) stated that implementing BIM has increased productivity from

28% in 2007 to 71% in 2012 globally. Past proven techniques show that over 75% to 85% of project managers' time is utilized in data handling & communication with stakeholders & project participants (Fisher & Yin 1992). Information flow in construction industry takes place manually in India with various teams involved in a particular project. When information flow takes place via entities or people involved in a project, there exists maximum possibility of miss-management of information & loss of data (Anumba et al 2002). Diverse & fragmented nature of construction industry leads to incompatibilities in construction process, thus leading to rework & waste of time when information management is done manually. Improper communication leads to misinterpretation of information & affecting time, cost and project schedule.

## III. ADVANTAGES OF USING BIM

The benefits determined are increased efficiency in collaboration and coordination amongst various stakeholders involved as well as increased productivity. In Architecture, Engineering and Construction (AEC) projects, one of the reasons that delays or cause failures is the challenge of data collection, thus highlighting that BIM prevents miscommunication and loss of information and helps in detecting problems from design stage itself. It helps in evaluating working hours as well as saving on clients capital investment. Various Project management teams are working on BIM and successfully delivering large scale projects. BIM standards in our country must be prescribed,

just as it is followed in various countries across the globe. Each country has its own standards depending on its geography.

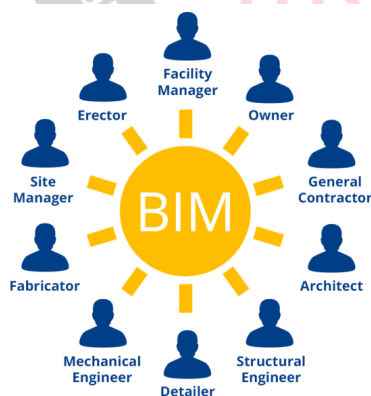


**Figure 1: Projects with BIM adoption compared with projects without BIM implementation.**

These standards help all project participants stay coordinated and aid in prefabrication and evaluating the combined performance of materials & components. Thus, BIM and its reputation for being able to provide more information and data compared to traditional workflows can benefit project managers in eliminating some of the risks associated with data collection. Currently, stakeholders including project owners, project managers, execution teams etc. are re-thinking the execution processes. In doing so, the AEC industry is at a stage that its stakeholders are considering implementing such tools into their everyday practice.

#### IV. PLATFORM FOR STAKEHOLDERS

Some researches show that there are apparent benefits to implementation of such new technologies (Demian & Walters, 2013). BIM provides a platform for all the stakeholders to co-ordinate and share updated drawings and is also of immense importance while developing a project charter. In any AEC type project, there are many stakeholders from different organizations involved. Each of these stakeholders



**Figure 2: BIM: a platform for stakeholders**

has their own project manager. This means that there are multiple project managers involved in these types of projects. BIM provides a platform for all these people to get engaged in the development of a construction project- right from the Architect, Structural Engineer, Mechanical Engineer, Owner, Facility manager, Site Manager, Fabricator, General contractor, etc. In AEC type projects, architects are the sole responsible entity for delivering a

well-documented and coordinated drawing set and thus, they become the main project managers of such projects. BIM and its 3D modeling capabilities have become very popular among architects; it has also altered project managers' traditional roles.

#### V. DIMENSIONS OF BIM

3D, 4D, 5D, 6D, 7D & 8D, each has its own purpose and is useful in finding out how much a project would cost, its timeline, and how sustainable it would be in the future. A BIM model can be utilized for pre-defined specific purposes before execution of a project. According to project stage requirements and project complexity, specific parameters are added to the existing information contained in BIM.

BIM is a software driven interface which provides the project delivery team with a virtual 3D visualization of the look & feel of the building to be constructed. The traditional building design depended largely on 2D technical drawings (plans, elevations, sections and others). Building information modeling extends this beyond 3D, augmenting the three primary spatial dimensions (width, height and depth), including time as the fourth dimension (4D), cost as the fifth (5D), estimation as the sixth (6D), facility management as seventh (7D) & safety factor as 8D.

#### VI. GLOBAL ADOPTION STRATEGIES

Before BIM came in to existence, information management was done with e-mails, SAP for information management, manual documentation of daily progress reports and field book, etc., construction project extranet tools. Such manual work would sometimes get lost by entities or misinterpreted by the verifier. After BIM was introduced in AEC, advantages of BIM implementation started getting recognized by monopolies of the construction industry across the globe.

BIM has helped eliminate recurring data, avoid multiple revised drawings, provide more accurate data, appropriate exchange of information between project participants and most importantly, on time supply of data on cloud, which can be accessed from any place even outside the worksite.

McGraw Hill (2014) stated that use of BIM has increased from 28% in 2007 to 71% in 2012 in North America. Countries like the United States, the United Kingdom, the Netherlands, Singapore, South Korea, Japan, Hong Kong, Australia and few other countries have mandated the use of BIM in public sector. Many countries in the regions of America, Europe and Asia have a high percentage of BIM users for their AEC projects. BIM awareness is spreading globally with the benefits it is offering to the AEC industry. BIM has been researched in more than 65 countries (Amarnath, 2016). Global trends in BIM research article provides us with an overview of BIM research. BIM has been adopted in the tertiary education system in more than 25 countries. Most countries have planned strategies to

implement BIM technology. Critical strategies for successfully using BIM in these countries include: strong government support and leadership, further improvement of BIM standards, education and training on BIM certification and BIM technology (Smith, 2014). When BIM development strategies of different countries are examined, it can be observed that the most preferred strategy is, the investments towards information technologies and research in the construction industry, which is implemented by many countries. The second most preferred strategy is 'Establishment of an organization such as BIM Task Group to assist and support public sector clients and the companies which make businesses with private sector, which is preferred by 5 out of 15 countries.

BIM DEVELOPMENT STRATEGIES	THE U.S.	UK	SINGAPORE	DENMARK	NORWAY	FINLAND	FRANCE	GERMANY	JAPAN	AUSTRALIA	BRAZIL	Total Mention	AUTHORS
To canalize the investments towards the information technologies and researches	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		9	Granholm, 2011; Kubba, 2012; McGraw Hill, 2014; Smith, 2014
Establishment of an organization such as by government to assist and support public sector clients and the companies	✓		✓		✓		✓			✓		5	CIBER, 2012; Kubba, 2012; McGraw Hill, 2014
To impose obligation to use BIM in public projects	✓	✓		✓		✓						4	Granholm, 2011; Khemlani, 2012; CIBER, 2012; Kubba, 2012;
Establishment of strategic initiation mechanism	✓	✓	✓									3	Khemlani, 2012; Kubba, 2012; BuildingSmart Australasia, 2012
<b>TOTAL</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	

**Figure 3 BIM development strategies in various countries.**

## VII. BARRIERS IMPLEMENTING BIM IN INDIA

BIM implementation in the Indian AEC industry has been restricted due to many barriers, which can be categorized into following groups: technical, people, educational & training, legal, and commercial barriers. It has been observed that the Indian industries have always been slow in adapting to new technological developments. But for BIM to be adapted successfully there is a need to change these work processes. The fragmented form of this industry is a problem; as this change cannot be adapted by single entity but, must instead has to be adapted by all stakeholders. Adaptation of BIM focuses on integration, collaboration and innovation connected with large cultural changes in the construction industry. This presents a way of categorizing relevant factors connected to the slow BIM adaption in the AEC industry. These categories are in terms of product, process and people. The reason for the slow BIM implementation is not simply one single issue, but rather the combination of several issues (Kiviniemi, 2013). In order for BIM to be adapted on a broader front in the AEC-industry, all of these issues must be considered. To get an understanding of the hurdles that our Indian AEC organizations are facing, extensive literature survey is performed and discussions are held with industry stakeholders to collect a possible list of barriers for delivering BIM projects. Technical group is sub categorized

as expensive software and hardware configuration. People barrier is classified in to subgroups as client driven limitations, less importance by project team members towards BIM implementation and lack of trained & certified workforce to operate. Education & training barrier is categorized as, lack of BIM education, skill development issues and organization efforts. Legal barrier is sub categorized as liability of copyright issue, National Building Code & third party dependency for accuracy. It is the prime requirement for the Indian AEC industry to overcome these roadblocks to progress further in BIM implementation in AEC projects and to stay competitive in the Global AEC industry. It is worth to note that there are at times miscellaneous barriers in utilizing these technologies that might result in project failures. There are times when not all the project managers from various consultants are utilizing same project management platform to execute and deliver their portion of the work. Thus it can have adverse impact and hamper the development of the project unanimously. Study show that implementing BIM without complete knowledge of the system has led to failure of the project in totality.

## VIII. LEGAL ADVICES

A legal issue with BIM as a new type of construction document, one of the first issues needed to be addressed is the ownership of the model. The project owner who is paying for the design might feel entitled to own the model, but other project team members might have provided property information and such information needs to be protected as well. The question of ownership of the model must be solved uniquely in every project owing to different circumstances. Connected to these issues, discussions regarding licensing can arise when project team members other than the owner or the design team contribute information which is integrated in the model (Thompson and Miner, 2007). The process of updating data over BIM and assuring accuracy entails a great deal of risk concern for BIM users which offers of limited warranties and disclaimers of liability for the design team, are the essential negotiation points that have to be addressed before BIM technology can be adapted. The ability to extract fast cost calculations and schedules from a model which are added with dimensions of time and cost will enable more efficient estimations. With this comes the issue of responsibility for interoperability between the various programs being used. When data is delivered in the same software, integration between different factors can fluctuate. When data is lacking or delivered through different scheduling or costing programs with lacking interoperability, a project team member must re-enter and update the model to include the new data. According to Thompson and Miner (2007), the responsibility for the accuracy and coordination for cost and scheduling data must be contractually addressed.

## IX. CHALLENGES



The only problem with BIM implementation in India is the unavailability of trained manpower and training centers to provide training and handholding. Taking this into account, few private organizations have started training programs and training centers to increase the adaptability of BIM in our country; as adapting BIM will have a positive impact resulting in greater efficiency in future of construction industry. This research paper compares both, advantages and disadvantages of BIM implementation into the project management process. The challenge is mainly mentioned to be lack of knowledge about BIM and how it alters the roles and responsibilities of project managers from that of the traditional process. It usually takes time for an entity to adapt to the new changes and figure out the best practices utilizing this technology.

## X. CONCLUSION

The problems found in typical information management systems in building construction projects have been pinpointed through analytic data and visualization of information flow. Benefits and challenges of implementing a BIM-based solution in such projects have been identified qualitatively; it was only possible to measure some of these benefits and challenges. Preferred strategy is to channelize the investments towards information technologies and research in the construction industry by Government of India. Efforts towards setting up training centers and making it mandatory for project managers, Engineers & stakeholders to have BIM certification course before they are appointed and assigned with a construction project shall be prioritized. It is utmost important for Private sector to make it mandatory to implement BIM based software for predicting and forecasting of later construction stages in its initial phase. Many of the benefits identified here aligned with those reported in literature, basically including accessibility of large volumes of construction information. The BIM-based solution helps to achieve more accurate, on-time and appropriate exchange of information between the stakeholders & project consultants. These underlying trends were noted during this research, making a healthy collaboration among project participants.

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