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Analysis of Building Information Modelling and Scope of BIM in India

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Abstract **- The time has come were tiring process of using pencil, paper and complex drawings were the base of construction drawings. It is now all about BIM. Although building information modelling is now widely being popular in the developed countries, developing countries lack the facilities to adopt this process although it is a more sustainable construction process. Hence construction industry is labor intensive and is following the same traditional process of carrying out drawings by architects or designers and buildings constructed by contractors. The objective of this paper is to overview the applicability of BIM in various construction phases and the hurdles against its adoption.**

1. INTRODUCTION

BIM or building information modelling is an intelligent digital representation or a model based process for planning, designing, building, managing logistics and carrying out the process of operations and maintenance. It provides high integration of information for the construction process and enables the builder to present the building according to its physical and functional characteristics. BIM increases productivity, infrastructure value and quality. It generates information and designs the model of the building in an integrated database and collaboratively using one coherent system, it helps in the conceptualization and construction of the model by using 3D information representation. Assigning a platform for each building modelling in a cloud based programme of BIM360, it integrates the extensive detailing of MEP (mechanical electrical plumbing) systems and HVAC (heat ventilation air conditioning) systems.

2. GENERAL CONSTRUCTION CYCLE

In the normal construction cycle, the owner or the client expresses the basic requirements he/she wants in the infrastructure to the architect in charge. The architect completes a conceptual design and further makes a detailed design and forwards it to the structural engineer who prepares the structural analysis of the building. The building drawing is further forwarded to the MEP engineer who completes the mechanical, electrical and plumbing systems drawing and hands over the drawing to department analysing and calculating the financial aspect of the building based on the drawing and builds a project time table and basic initial time chart. The drawing as well as the initial time and cost dependant information is handed over to site engineer who implements the design in the construction site. There are many problems faced from this type of construction. The one way communication between each project members brings about a conflict of designs between each drawing. This leads to complexity of the project and project performance challenges. The lack of communication would lead to a clash between drawing of each engineer which could be found out only during the construction, this leads to wastage of time, money and labour which causes the over budgeting of the project.

3. BIM CONSTRUCTION CYCLE

In the BIM construction cycle, there exists a common platform called BIM360 which can be accessed by the client. The various engineering models are drawn and uploaded to this platform in accordance and in reference with the other models in the platform. This increases communication between the project members.

All the project members consisting of managers, design engineers, shop workers and contractors allot and convey information regarding coordination of tasks completed and yet to be completed and design processes and updates of changes in the model, thus ensuring the project is under control by all the project members.

4. BUILDING LIFECYCLE IN BIM

The general building life cycle starts when the conceptual design is built based on the requirements of the client. Further, a detailed design is modelled by adding the desired type of doors and windows or even furniture by using the library options. It elaborates and external and internal model with a walk through and fly through animation. Additional designs and content libraries can also be downloaded. Options for making separate designs and adding them to the library is also available. The structural analysis of the building is done to check the stability and the model should establish the different components of the building and its constructability. The MEP models are also integrated to this data to complete the virtual construction of the building. These files are sent for documentation to further get approvals necessary and start the construction. These drawings are even sent for fabrication processes to construct shop drawings and build steel precast steel and other structures as the can draw details about the exact measurements needed. The design phase of the building using BIM has a lot of advantages as to the standard existing ways. As compared to the normal drawings and modelling, changes made in plan or any particular view is automatically reflected on the 3-D model. Softwares used for these processes include Revit (Autodesk), ArchiCAD (Graph iSOFT), AECOSIM (Bentley), etc. BIM also allows the clients to keep a track of the ongoing work and the rate of

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work completed. They can simply download BIMx mobile application to view their projects. This enables them to make corrections according to their requirements. The contractors can also keep track of the construction and give his/her input based on field experience.

5. MAIN FEATURES OF BIM

5.1. CLASH DETECTION

Clash detection is a main feature included in building information modelling. Each component in the model is associated with a specific type of system.the BIM- based clash detection programme allows members of each system to effectively identify the clash between specified systems and checks the clash between the mechanical and structural modelling. This programme allows clash detection at any level of the detailed drawing. It detects the 4-D aspect of drawing,ie., the clash in management of workflow. Clash detection can help the contractor realise the difference made between different drawings and help to foresee the difference. This saves time in construction and effectively, money and labour. It reduces the financial and project related risks of the many aspects of the building regarding design and construction workflow. Bim gives a detailed information regarding construction detailing of the building model,ie.it elaborates the 4D, 5D and and scheduling of the building model.

5.2. ENERGY ANALYSIS

Efficient energy analysis is another main advantage BIM provides. Generally building take up 40 percent of the global energy. BIM provides energy analysis of the building even before it is actually constructed. The location of the building is set up before the building is modelled. The direction and intensity of sunlight, rainfall and wind can be estimated using the weather forecast. This can be analyzed to find out the material to be used on certain points of the building to ensure maximum energy efficiency. Materials to be added to ensure the least amount of external energy to be given to the building is estimated. Generally the most comfortable human temperature for a building is 75 Fahrenheit. Materials can be chosen from the library in Revit and added to the model to attain a temperature close to the ideal temperature. After the analysis the additional energy requirements of a building for ventilation, temperature control etc. is found out. If the materials of the building is already predetermined, energy estimates and additional optimizations are suggested. Application Softwares which include TRACE700 and ECOTECT are used to carry out these processes to make the building more energy efficient.

5.3. COST EFFICIENCY

Bim helps in reviewing the cost estimates at a faster rate. Estimates planned in bim have an accuracy of upto 3% and upto 80% reduction in time in estimation. As it reduces the financial risks related to the construction and design. BIM quantity take-off tools/plugins share a more accurate area and material quantities information within the model. 4-D schedules are analysed and reviewed using model based schedule visualisation. 5D cost planning and target costing with model-based feedback improves the predictability and manageability of the project and reduce inaccuracies upto 3%.

5.3. SAFETY ANALYSIS AND CHECK ON THE PROGRESS OF WORK

When the design phase is completed, a 5D construction schedule is planned so as to keep a track on the progress of work. Site engineers, design team and the labourers work together to negate any clashes if dealt with. The required target rate of work is compared to the actual rate of work and the delays are added in workflow. Software generally used for this purpose is Navisworks where safety analysis can be done and the site logistics plan can be prepared.

5.4 DEMOLITION

BIM plays a major advantage to the demolition of a building too. As the materials used for construction, the general construction workflow and the approximate weather conditions are added to the model, an approximate life of each model will be specified in the BIM model. This allows the contractors and the clients to plan ahead and estimate the amount of usable materials. The position of explosives to be placed for demolition of the building can be analysed and found out and the explosion can be maintained and simulated. Softwares like Extreme Loading for Structure (ELS) are used for this purpose.

Table 1. The efficiency difference between CAD and BIM applicationsfor a particular project in different phases

Task	CAD (hours)	BIM (hours)	Hours saved	Time savings
Schematic	190	90	100	53%
Design development	436	220	216	50%
Construction documents	1,023	815	208	20%
Checking and coordination	175	16	159	91%
Totals:	1,824	1,141	683	

Source: (Rick Rundel (7), 2007)

5.5 QUANTITY SURVEY

Manual quantity surveys take a massive time range and may have an inaccuracy of about 5 to 10 percent which is a huge loss compared to quantity surveys performed in the BIM process in softwares like Vico office which increase the manageability and predictability of the project. With a wide range of library option, BIM can enable a quicker extraction of information regarding the quantity of the materials needed, its rate, and cost formulations, etc,. This improves

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the 4D schedule for the rate of work done and the 5D aspect of the work which include the cost estimation, thus saving the client from an over budgeted project.

5.6 QUALITY MANAGEMENT

The programme has complete information regarding the location, the weather data and the type of materials used in the building. Thus the programme can predict the amount of maintenance required in the required period of time. This helps keep the quality of the building in check. The work during the construction is also predicted and the rate of work is constantly kept in check to ensure maximum workflow effeciency.

6. ADVANTAGES OF BIM

By now we can understand that BIM can yield a better construction process with increase in quality and reduced cost. It has revolutionised the AEC industry changing the way buildings are designed,constructed and function.

1. The main advantages of BIM is that different stakeholders in construction are connected throughout project to increase the communication between the members which eventually leads to the transparency of the project.
2. It provides an easy clash detection simplifying the construction process which helps increase the rate of workflow and ultimately reduces the cost.
3. It makes the maintenance operations easier and increases overall productivity.
4. It provides an accurate project cost estimation and maintenance details.
5. It helps in predicting the approximate lifetime of the building and analysing which materials in the building may be used after the demolition.
6. It accelerates the issuing of different building parameters and documentation works which makes the processes of approvals and sanctioning more rapid.

7. DISADVANTAGES OF BIM

Although BIM is rapidly being accepted in more countries the have a few setbacks which makes the adoption of BIM process an arduous challenge.

1. Lack of expertise in the BIM industry is a major hurdle and companies need to require money and time to train their professionals to adopt the technology.
2. Ownership of BIM and copyright issues are a major challenge that makes companies less enthusiastic for bringing about this change.
3. The lack of compatibility to communicate with different stakeholders and their disinterest to share their work to the other members of the project.
4. Legal framework of the country has to be more to these contractual agreements.
5. The high initial cost makes it less attractive for companies to acquire BIM software packages.

8. SCOPE OF BIM IN INDIA

As the rate of the BIM movement is flourishing it is evident that BIM will soon replace the CAD systems. New applications supporting BIM in mobile phones will help contractors, designers and the AEC industry in general to constantly keep a check on the developing designs of the model and apply corrections immediately,creating a better communication with the stakeholders of the project.

Developed countries have already reaped these benefits from BIM, by the digital representation of the building from the conception to its demolition. The several processes of BIM from designing, analysing, evaluating and programming its maintenance operations have become a revolutionary boom in the AEC industry.

GLOBAL BIM REGULATION

Austria	Likely to be in place 2018
Belgium	No regulation to-date
Brazil	Roadmap under review / consideration
Canada	No regulation to-date
Chile	BIM Mandated for 2020
China	BIM required through the 12th national Five-Year Plan

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Czech Republic	No regulation to-date
Denmark	Mandatory requirement since 2007 (extended adoption in 2011)
Dubai	Mandated since 2013
Finland	Senate Properties 2007 Finish Transport Agency – Inframodel 3 (LandXML) (2014)
France	Mandated for 2017
Germany	Mandated for 2020
Hong Kong	Mandated in place since 2014
Ireland	Roadmap to Digital Transition for 2018 to 2021
Italy	Mandated for 2019
Netherlands	No Mandate
New Zealand	No regulation to-date
Norway	Mandated since 2016
Portugal	No BIM requirements planned
Scotland	Mandated for 2017
Singapore	Mandate in place since 2015
Spain	Mandated for 2018
Sweden	Mandated for Swedish Transportation Administration
Switzerland	No Regulation to-date
United Kingdom	Mandated since 2016
USA	Multiple Mandates through different states

Information reproduced from: *McAuley, B., Hore, A. and West R. (2017) BICP Global BIM Study – Lessons for Ireland's BIM Programme Published by Construction IT Alliance (CitA) Limited, 2017. doi:10.21427/D7M049*

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Developing countries like India is in dire need to use BIM beyond a few infrastructure projects to tackle delayed deliveries and easy detection. Hesitation of completely restructuring the construction organisation in india roots from the lack of expertise of this technology and the complications related to the ownership of BIM data and copyright issues. Reluctance to change the traditional processes is due to the high initial cost of BIM software packages and the time and money to train the professionals to use BIM. Legal framework of the country which assumes a less collaborative environment and delineates responsibility also is a major drawback of assuming BIM in India.

9. CONCLUSION

BIM is a revolutionary boon for the AEC industry. BIM Digitalises the life of a building or a group of buildings to deliver optimised solutions in every phase from its conception to demolition. Processes like clash detection and energy analysis reduce a major cost of the building and improve the efficiency of the construction. Developed countries like the USA or UK have already reaped benefits from BIM. But the BIM usage and level of BIM adoption in developing countries like India is low. The Indian construction industry can tackle delayed deliveries and detect design clashes easily by using BIM. A collaborative effort is necessary from the Government and private sector firms to increase the usage of BIM in India.

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