NECESSITY OF IMPLEMENTING THE DIGITAL TECHNIQUE IN CONSTRUCTION INDUSTRY USING BIM

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ABSTRACT: India is a country where most of the construction industries are still continue to their traditional way of working by manual means at construction site. This slow pause of transformation of traditional way of working into digital techniques chasing many problems for Architecture, Engineers and Contractors (AEC) every day to accomplish their work at time. According to the survey only 40% projects are completed on time and rest 60% projects are recorded under the budgets in India. Though, each and every construction industry has to follow their own protocols and sometimes might causes delay in completion of project, thereby, reduces the productivity and badly affects the annual turnover. The economic problem faced by construction industries may be reduced by adopting advanced digital techniques for construction projects. A digital technology like BIM is a future trend of construction industry and need of time of the development country like India. Implementing the BIM technology in construction industry may helps to improve the quality of design, construction and reduces the cost as project management is effectively controls by digital techniques.

KEYWORDS: BIM, Steel structural building, Construction Technique, 4D, 5D Modelling, Neural network.

I. INTRODUCTION

India is an emerging country which has been suffering from economic issues due to delay in completion of huge infrastructure projects. Many organizations which are involved in public/private construction sector or in procurement area such as designer and contractors need an advance technology for faster progress of work in construction sector. Design or plan statements must be changed from 2D to 3D interface in construction industries. People working on a project do not have any effective tools which help to incorporate the updated necessary changes made at any stage in a project. The insufficient information created a communication gap and raised clashes between owner, designer, contractors or any other vendor involved in the work and is responsible for delay in completion of a project. This problem may be tackled by adopting digital technology which not only helps to increase productivity, quality of work but also reduce lifecycle cost of whole project. Building Information Modelling (BIM) is a closed collaboration of people which facilitate digital storage of all types of data of a particular project. It provides integrated project delivery (IPD) in a project which combines people structures, and systems in a project work automatically with each other. It instigates the spectacular transformation in business practices for all stakeholders and provides modern status of BIM for project sustainability. Since the implementation of BIM is increasing in Indian Construction Industry with each passing year, it can solve these types of issues very efficiently. Union Nations have also undergone with different changes in construction techniques which provide solutions to evaluate different problems faced by Indian Construction Industry. The Construction of Nagpur metro station in Maharashtra is the best example of execution of BIM oriented new project in India. It monitored the raised area mainly known as 5D BIM which helped the project team for reducing the time, cost and legal actions from 20,000 crores budget. Nagpur Metro station project is based on digital project management policy and is integrated with SAP 5D BIM technique. This technique helps the project managers to create different models to show how the changes involved in metro design work, construction material and layout might increase the quality of project delivery. The most important factor in construction project is to manage the cost and time. To handle these factors, India needs 4D and 5D BIM that generates a solution key against these problems by applying visualization design application (VDA) and IPD techniques. The construction projects based on 4D BIM technique visualizes the animation work and develops a sequential phase which shows the critical path between process and model schedule. On the other hand, 5D BIM process reduces the engineering cost which firstly generates bills of
calculating items and then evaluates financial scenarios of the project work. To solve this problem 4D progress tracking system is used to evaluate cost and change objects into earned value. It provides lot of advantages in cross section of different construction projects [8]. Some of the software like Autodesk Revit, Free CAD, Navisworks, Tekla structures, Glue, Bentley ConstrucSim and Vico office suit etc. are used as BIM software all over the world [8]. Autodesk Revit is most commonly used BIM software which is adopted by Indian construction industry. Usually, AEC industry uses Autodesk Revit for their BIM applications which contains architectural design features and Mechanical Engineering Plumbing (MEP) is used for structural engineering designs. For, any successful BIM project, cost simulation factors (CSFs) are necessary to evaluate [9]. Formation of 4D model for construction work, Revit generates 3D model which creates geometrical design and transfer digital information to the project manager. To import this 3D design model, Revit software directly links with the Autodesk Navisworks utility tool which permits the consumer to open and combine 3D model with time and cost factors. Tekla is second mostly used BIM software in Indian construction project. This software facilitates user to create or manage 3D models with concrete or steel which evaluate design and analyze level of development (LOD). Various groups of designers, engineers, producers, architectures and contractors offered BIM technology in initial or final stage. The major problem arises in the adoption of BIM is lack of software information, knowledge and its high operational cost. Due to this reason, the construction industry of India prefers traditional techniques of construction process using manual modes. Practice of these traditional techniques is not an issue in India, but the delay in work affects the deadline of completion of a project and there by affects the budget and economy of project. Therefore, it is necessary for Indian construction industry to adopt BIM techniques for construction projects

Investigation on usage of BIM Applications in Indian Construction Industry through Online Survey and offline

In this phase of research, the online survey was conducted to know the assortment of current BIM applications in Indian construction industry. To identify the real facts, a questionnaire consists of 25 set of questions was prepared and circulated to different associations like IBIMA and other infrastructure construction companies in India. The number of questionnaires were asked from IBIMA and various BIM associations by conducting online survey which is working for Indian construction projects. The output received from the reviewers through online survey. The specific features of this survey has been shown in Figure 1 below.

![Diagram](image)

(a) Stream of people in BIM organization (b) Implementation of BIM with organizations (c) BIM employs in different organizations (d) BIM Software usage in India.

Figure 1. Usage of BIM applications in last few decades of Indian construction industry conducted through online survey.

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Level of BIM interest

In India, numbers of BIM software are available in market which are now used by private Indian companies in different sectors. Design technology of BIM came with lot of advantages which are supported by private investors and it is not exactly possible to judge the level of work done by companies through BIM techniques because of its digital work. But it is necessary to evaluate, how BIM project manager creates good condition at the workplace?. BIM creates better shape of project by excluding and minimizing the wastage of time and cost.[8]. The level of interest shown by Indian government policies, private investors, architectural and construction industry towards BIM is extremely essential. The level of adoption of 4D and 5D BIM applications used by IBIMA and other BIM companies and Government policies in Indian construction projects was studied by conducting online survey.

II. PROPOSED METHODOLOGY AND STAGES OF IMPLEMENTATION OF BIM IN INDIA

The current research was based on some proposed methodologies and has been divided into three main stages for exploration of research data. Exploration criterion were preceded only by taking secondary data of different elements. Decision making is essential for the establishment of 4D and 5D BIM techniques in the project work. To do so, the system was divided into various stages in a systematic way for calculating overall progress of the work. The flowchart of overall progress of work includes research discovery, questionnaire, objectives and methodologies. The three stages of projects with their description under which online survey, formulation of 3D model in different software and 4D & 5D BIM applications were also taken into consideration. To understand the 4D and 5D BIM technique, it is essential to know the significant details of BIM packages of work at construction project site. Because, lack of knowledge might creates economic issues. The system required a detailed chart which evaluate the overall package of work and analyzed the different factors which are related to BIM. This level of significant details ranges from insignificant to crucial stages which are properly defined by systems. The implementation of BIM in India is not popular because of lack of awareness about software and digital technology know how. Rarely people know about BIM, it is necessary to take an initiative and use this technology for emerging development of our country. In current research various BIM software’s are used for evaluating cost and time factor. The 2D Plan and 3D View of Residential house building model was created on Autodesk Revit software. This model helps in designing and operating different part of projects at various stages of construction project during different construction operations as shown in figure 2.

Figure 2: 2D Plan and 3D view of residential house building model created in Autodesk Revit software

When the IFC files were exported from one system to another system, the whole output data got messed up with each other and the model formed was not exactly same as it was created using first software[9]. This is one of the major issues generally found in software designing called as interoperability and need to be checked while using more than one software. To understand this problem in a better way, two different models were created on different software. Software like Autodesk Revit and Free Cad were used for evaluating the interoperability issues. The overall information provided by application model describing their links with multi model and also with collaboration processes [10]. A two story residential house model in 3D was created using Autodesk Revit and Free Cad. From the output files, it has been observed that the few elements of the construction projects were found missing during interpolation when imported these models from one to another software. Thus, generated a digital report with errors after completion of process. The same problem was realized during exporting these models with each other, when Industry Foundation Classes (IFC) file format was used.
House Model with IFC File

IFC is the only single opened 3D object oriented system in a BIM software which contain ISO certificate.[6] It generates 3D geometrical view for all components of model which store data and standards of every part of designed model. The applications used by different software’s are quickly identified and filtered by IFC databases models. But when these are created in different software are not capable of transferring their own elements or data during importing or exporting process. The peculiarity of the software is that it excludes some elements from its place or deletes some data during process either importing or exporting the file in different software and later can be included as and when required.

III. DATA ANALYSIS

4D Simulation of Work using Navisworks Freedom:

The objective of the current study was to ascertain the 4D and 5D BIM advantages in construction projects and to learn the six major aspects of work i.e. cost and estimation, 3D organization, construction planning, 4D and 5D visualization, validate model and monitoring process. The first step of illustration of 4D BIM model contains design of 3D model in any software[4]. The procedure of analysis of 4D BIM i.e. time analysis was simple and short. In present study, Auto CAD Revit was selected for 3D design work. The 3D model named as Building house model was constructed using Autodesk Revit software. Another software named Navisworks was used for further time analysis process. Navisworks contain three utility programs in which Navisworks freedom, Navisworks manage and Navisworks simulate were used for 4D analysis[3]. The 3D model which was design in Autodesk Revit was imported in Navisworks Simulate. Then overall data of MSP file and other CSV (CSV) files were transferred into Navisworks Simulate. It contained time liner which include task, activity, name, status, planned start, planned end, actual start, actual end, task type and total cost columns were inserted at one side and on other side the data from activities containing regular Gantt chart was inserted. For 4D analysis of Revit, 3D Bulding House Model software like Navisworks Freedom, Manage and Simulate were used by importing MSP files data of project into Navisworks Simulate and forming Gantt chart of overall construction project with time factor.

5D Cost analysis of residential Building

After formulating the time schedule, another important aspect of BIM was cost estimating which was the next essential feature of building process that provide lot of benefits regarding building information. Autodesk Revit was used for estimating cost analysis which is known as 5D modeling in BIM. Digital cost estimating automatically accounts for different deductions in estimation by quantifying them digitally i.e. it take measurements directly from the model and these are: Application programming interface (API), Open Database Connectivity (ODBC) connections and Output to Excel. API creates direct link between Revit and costing system. BIM create common language for all people who join with the firm and develop integrated system. ODBC database access the information of building model and export 2D and 3D CAD files into software which connect the dimensional information. In next approach it creates material takeoff in Revit software and finely forming a data output on excels spreadsheets and handed over to the user of the project.

Cost estimation

The main advantages of Autodesk Navisworks is that it is not only used for 4D factor but also used for 5D i.e., cost factor analysis. Navisworks freedom defines the task work properly after analyzing the time and evaluates the total cost factor of project as well. The overall cost of 3D design model can be evaluated by analyzing different component of model and generated cost of that component. The cost scheduling of 3D Model on NavisWorks Freedom is shown in figure below.[9]

Figure 3: 4D analysis of Autodesk Revit 3D House Model in Navisworks freedom software.
Cost data can be evaluated by importing data of Revit Autodesk. Similarly, time data can be evaluated by importing MS Project data in Navisworks 2 for superior visualization and simulation design purpose. Four different variety of simulation colours were obtained after visualizing and simulating the building model as shown in figure 3. The description of various colours has been given below:

**Green:** - Which shows that the project is within the cost and earlier than time schedule.

**Grey:** - It indicates that the project is within cost and after the time schedule.

**Dark Grey:** - represents that the project is more than the cost and earlier than the time schedule.

**Blue:** - shows that the project is more than the cost and after the time schedule.

IV. RESULTS

1. Calculate actual cost of 2D drawings elements by using traditional technique and named it as **CA1** (Cost analysis 1).

2. All elements of BIM residential house model are taken in to the account and compare the 3D model with actual cost estimated by traditional technique and named it as **CA2** (cost analysis 2).

3. Actual cost evaluated on spreadsheet by calculating all preliminary and secondary data of project is named as **CA3** (cost analysis 3).

By using Budgeted Cost of work performed analysis (BCWP) variance of the project can be determined:

\[ VA1 = CA1 - CA3 \]
\[ VA2 = CA2 - CA3 \]

Further these values can be compared by results of research work.

V. CONCLUSIONS

Based on the output of the models, the following conclusions have been drawn:

1. BIM creates efficient and effective developing method which is intensively required by any industry to improve the progress performance by reducing the

   (i) cost and budget issues,

   (ii) time issues,

   (iii) lack of information issues and

   (iv) Issues related to delayed services of project work.

2. Number of problems arises during execution of a project in construction industry can be solved easily by using 4D and 5D BIM technique.

3. 4D BIM provide great impact on construction project against traditional techniques. In country like India where visuality of construction progress work is not so clear, it provides much better visualization and communication of project work which provide great efficiency.

4. It eliminates the possibility of rework and clashes happened at construction site by detecting the root cause of the problems at earlier stage, which helps to remove budget regarding issues and increase economical factors.

5. However, the lack of knowledge about BIM creates problems to the society, although creating 4D and 5D models with small elements is also very expensive. But this problem can be solved by budget control process.
6. It helps to remove the unbudgeted changes properly that may arise during project execution at different levels and attained 80% time reduction and 20–30% cost reduction of measured cost schedule which is far better than the manual construction technique adopted by Indian construction projects.

VI. REFERENCES


