

Evaluating effectiveness of BIM application in Construction Projects

S. M. Dodia¹ and S. Hariharan²

¹ME Scholar, Department of Civil Engineering, Sardar Patel College of Engineering,
Andheri (W), Mumbai-58.
shreyans_dodia@rediffmail.com

² Faculty, L&T Institute of Project Management, Vadodara.
hari4444@yahoo.com

Abstract: *The purpose of this paper is to evaluate the effectiveness of Building Information Modeling (BIM) as method of quantity estimation versus conventional methods. A case study of a residential tower situated in Mumbai is taken into consideration for the comparative analysis. The methodology to be used consists of three stages; model creation, scheduling, and cost estimation with the help of BIM tool. The difference will be then compared between conventional method of estimation and BIM based one with regard to time, accuracy, ease in access and future scope. It is to be noted that BIM has gained popularity in recent times and is also mandated in international projects. The results of the analysis shall be useful in understanding the effectiveness of the tool and to explore innovative means of application of BIM in projects.*

Keywords: Effective planning, cost estimation, Building information modeling, 5d model, project co-ordination.

1. Introduction

The Indian construction market has been experiencing a shift in its expectations and processes involved due to economic bloom; this challenge is readily accepted by the architects. The conventional 2D based documentation is shifting to a practical reality with respect to economic, functional, energy, etc. Construction, structure, architecture, electrical, mechanical, and even management involved in a project can share a single source of database. Predictability of construction costs has become higher and accurate. The use of parametric 3D modeling allows BIM to generate conventional 2D drawings such plan, section, elevation and other documents like schedule and costs automatically. The mistakes in coordination are eliminated as the changes made in the model are coordinated automatically throughout the project which improves the overall quality of work. The construction industry has been in a need to change and improve the current methods of scheduling and costing. The motivation of research in visualization into these methods has been due to failure of conventional methods.

The BIM tool has a significant growth in utilization in the recent years so it has been seen as a necessity to evaluate the effectiveness of the tool in the construction industry.

2. Aim of the Study

To thoroughly understand the process of Building Information Modeling with regards to Construction projects and evaluate the effectiveness of its application through cost estimation by BIM tool versus Conventional methods. To thoroughly understand the process of Building Information Modeling with regards to Construction projects and evaluate the effectiveness of its application through cost estimation by BIM tool versus Conventional methods.

3. Literature Review

A variety of literatures were reviewed giving us the summary as follows; The ability of BIM regards to the 3D visualizations it can produce is very useful but at the same time its current limitation keeps it away from full exploitation. Fully integration of BIM has to be done first. According to Eastman (2011), just buying and installing numerous software is not BIM, but it is the software and the process involved. In order to implement BIM fully a lot of changes in cultural and behavioral transition of the industry and business practices currently being used has been pointed out by Azhar et al., (2008). During the phases of planning and construction there is a dire need of cooperation and good communication between the different parties involved. These identified issues motivate us to utilize and adopt BIM in Indian construction industry.

4. Objectives of the Study

- Understand BIM capabilities over traditional methodology in India.
- To leverage BIM in Construction management with Indian perspective.
- Innovation through fulfilling existing requirements with new technology.
- Evaluate effectiveness of BIM Tool in construction industry.

5. Scope of the Study

- Preparation of 3D and Estimating cost using BIM in Indian Construction Scenario
- Comparing the same with conventional Estimating process

6. Methodology

The process of estimation can be carried out by much software on different platforms. Due to ease in availability and familiar interface and licensing terms we have used the Autodesk platform.

Applications to be used:

Platform: Autodesk

- AutoCAD
- Revit
- Navisworks Manage

Supporting Software

- MS Project and MS Excel

Procedure:

The Procedure to be followed can be well understood by the Figure 01 given below and the software to be utilized as per detailed description above.

Step 1: Model Creation

- Creation of a Model by Revit- If an AutoCAD drawing is already available just import the drawing from AutoCAD and raise a model over it.
- Simultaneously you can provide specifications of materials, its suppliers, Details of required resources etc.
- After completing the details of the model export the model to Navisworks by using export with file extension .nvc, i.e. Navisworks Cache File.

Step 2: Scheduling

- Work Breakdown Structure is to be created using Microsoft Project(MSP) of the Model.
- The activities are linked and proper schedule is made in MSP.
- The Schedule can then be exported to Navisworks Manage.

Step 3: Cost Estimation

- Import the Model and Schedule to Navisworks Manage using Append tool.
- Use the Quantification workbook to perform the quantity take-off.
- After getting the quantity from the take-off apply suitable rates and get the total cost of the project. This can be easily done with the help of MS Excel.

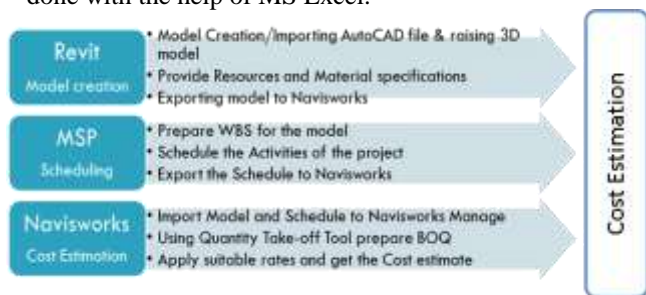


Figure 1: Cost estimation process to be adopted

7. Case Study

A case study is taken up to estimate the quantities with the help of BIM tool and conventional method to compare the results. The details of the case study are as given below.

Details of the Project

- Residential Complex
The case study is the residential complex which comprises of 4 Multi-storeyed Towers. All the towers in the complex are stilt + 2 Level car parking + 13 floors. The residential flats in the building complex are 2, 3 & 4 bhk type of flats.

Out of the four buildings this is under construction phase and its data will be used for the case study for preparing a cost estimate through BIM tool.

- Residential Complex
 - Location – Ghatkopar (West) – Mumbai
 - Built-up Floor Area – 5920 sq.ft.
 - Cost Estimated – Rs. 12 crores.
 - RCC Structure – Stilt + 2 level Car Parking + 13 floors.
- Data Obtained
- The detailed Architectural and Structural drawing are obtained from the site.
 - The Bill of Quantities is per Item and its rates are obtained from the client.
 - The data is to be utilized to form models, WBS, Preparing Schedule, Quantity Take-offs, and thus reaching to final cost estimate.

8. Results

The model of a RCC frame of a typical floor is developed and utilized to take-off concrete quantities. The Summary of the quantities is provided below.

Table 1: Summary of Quantity Estimate by BIM Tool

Sr. No.	Description	Total Quantity
1	Columns	54.692
2	Lift Wall	8.155
3	Beams	37.839
4	Slab	73.392
	Grand Total in cu.m.	174.078

Table 2: Summary of Quantity Estimate by Conventional method

Sr. No.	Description	Total Quantity
1	Columns	56.817
2	Lift Wall	8.140
3	Beams	45.727
4	Slab	63.093
	Grand Total in cu.m.	173.777

The difference between the Quantities estimated by BIM tool versus the conventional method is -0.2%.

The difference between the two methods can be due to omission, human error and the assumptions while carrying out the computation of the quantities.

After the model is prepared the quantities are obtained within a minute irrespective of the size of the model. While it takes days to estimate the quantities manually.

The model helps to create drawings when required and the updating of model is quick and is reflected in other linked drawings and estimates.

While the conventional method relies on previously prepared drawings and updating the project due to any change in scope causes rework which is tedious and cumbersome.

9. Conclusions

The utilization of BIM tool in Estimation has an upper hand compared to the conventional methods of Estimation according to the above results

- The BIM tool is quick and easy to carry out quantity estimation.
- The minute difference between the quantities obtained by two methods shows the accuracy and reliability of BIM tool for its stake holders.
- The huge amount of time saved in the process can be utilized by the engineer for other works. Thus providing a double benefit proving the effectiveness of the tool.
- The updating of project is easy and faster without any rework required.
- Drawings can be prepared whenever required from the model while conventional method relies on previously prepared drawings.
- No chances of human error is there while estimation through BIM tool.
- Better visualization through simulation is provided by BIM tool.

References

- [1] E. Krygiel, P. Read, J. Vandezande, 2011, Mastering Autodesk Revit Architecture 2011.
- [2] Willem Kymmell, 2008, Building Information Modeling Planning and Managing Construction Projects with 4D CAD and Simulations.
- [3] S. Hariharan, et al. 2014, Role of BIM in Reducing Information Asymmetry in Construction Projects – Evaluation of Australian and Indian Perspectives.
- [4] J. Vinoth Kumar and Mahua Mukherjee, 2009. Scope of Building Information Modeling (BIM) in India.
- [5] Eastman, C., Teicholz, P., Sacks, R., and Liston, K., 2011. BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. Wiley.
- [6] Azhar, S., Hein, M., and Sketo, B., 2008. 'Building information modelling (BIM): Benefits, risks and challenges', In Proceedings of the 44th ASC National Conference.