Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 7, July : 2024

BIM: A NEW WAY TO IMPLEMENT CONSTRUCTION PROCESS: A REVIEW

Prof. Aniket Patil, Assistant Professor
Dr. J. G. Nayak, Associate Professor,
Prof. Sachin Manjarwal, Assistant Professor
Apurva Gawali, B. E. Student
Department of Civil Engineering, Sandip Institute of Technology and Research Centre, Nashik, Maharashtra, India.

Abstract

The implementation of Building Information Modelling (BIM) in the construction process has emerged as a significant advancement in the field of construction management. With the integration of advanced technologies and digital systems, BIM provides a comprehensive platform for effective clash detection, 360 collaboration, cost-saving measures, and enhanced visualization. This paper aims to discuss the key aspects and benefits of implementing BIM in construction projects.

Firstly, the use of clash detection, a crucial feature offered by BIM, allows for the identification and resolution of design conflicts before the construction phase, thereby minimizing errors, rework, and potential delays. Furthermore, by integrating information from various stakeholders, 360 collaboration ensures effective communication, coordination, and knowledge-sharing, thereby reducing misinterpretations and conflicts among project teams.

In addition, BIM offers cost-saving measures in terms of optimized material procurement and utilization, accurate quantity takeoffs, and improved project scheduling. By leveraging such capabilities, construction projects can achieve significant cost efficiencies, reducing waste and maximizing overall project budgets.

Lastly, BIM's visualization capabilities enable stakeholders to have a realistic and immersive experience of the project throughout its lifecycle. This not only aids in better design communication but also assists in making informed decisions by evaluating design alternatives and understanding the spatial relationships between different building components.

Keywords: BIM, Visualization, Cost saving, Collaboration, Clash detection, Quantity take-off.

I. Introduction

Various forms of simulations have been used throughout the recorded history. The wooden project models built in the 15th-century Renaissance period were simulations, and so are the diagrams, drawings, and specifications that have been used for hundreds of years as instructions for building.

The information contained in these examples is, however, very limited and fragmented (disconnected from other parts of the information). The meaning of the word simulation in this book will refer to a single coordinated and integrated entity containing (or linked to) all required information to plan and construct a building project. The building information model is a project as well as a process simulation. The production of simulations should be carefully planned and intentionally implemented. This chapter discusses the basic concepts of the BIM, the planning, and the implementation processes. The BIM concepts section of this chapter describes the nature and characteristics of the BIM, the processes involved with creating and using the BIM, and the benefits of both the BIM's creation as well as its use. The next section of the chapter addresses the planning required to create and use a BIM successfully, including the development of goals for the purpose of the BIM, generating a set of specifications from these goals, and producing a plan for the implementation of the process. The chapter closes with a discussion of the realization of the planningphase, the selection of the project team, the deployment of the processes, and the specification of the deliverables. Proper care in understanding, planning, and realizing the BIM processes is critical for the successful implementation of a building information modelling approach to construction planning and management.

The planning and the realization of the BIM are very similar to the planning and the realization of theactual construction project. The simulation process will actually parallel the process that it is simulating; which is the main reason that the BIM is such an effective tool; the preparation process is in fact a rehearsal for the actual performance. Creating a BIM is labour-intensive and involves many persons on the project team; it is important for the BIM to meet the project team's expectations, and thus it should not be entered into naively. The implementation of this process should not be careless or rushed, as small errors can lead to much larger difficulties when not prevented early through proper planning and procedures. It is not uncommon for a modeler to reach a point where there is a very insistent urge to start over with the model (and this may well be the best course of action).These feelings result from the deepening of the level of understanding of the project and its processes, and suggest that there are numerous ways to improve the BIM. Often at this stage the BIMwill already be quite complex and detailed, and frequently editing the existing models may in fact require an effort as great as, if not greater than, that of starting afresh. Continual evaluation is an important part of the BIM development, and will be influential in the actual implementation of the process plan.

Since the understanding of the project develops through the creation of the model, it is possible that at a certain point the simulation (model) no longer accurately reflects that (increasing) understanding.This is the right moment to reevaluate the usefulness of continuing with the current model, or to restart a new one. Generally, it will take a fraction of the time that it took to get to the

same point of development because all the thinking and planning has now been done and the modelling has been well planned and can be executed efficiently. The result will be a new model that will no longer slowdown progress or be inaccurate in the way it represents the project.

A fundamental characteristic of the BIM is its development through an information feedback loop. The evolution of the model and the relevant project information is cyclical (iterative); and as the different project team members develop the project, the available information gradually increases in scope, depth, and relatedness. A coordinated and intelligent project will grow out of the building information that is continually cycled through the BIM at a more and more detailed and coordinated.

Project Models

In the last few decades, architects and engineers have begun modelling their projects in 3D space rather than drafting them in 2D plans. In many cases this does still not eliminate the need for 2D documentation for permits and communication with the other project team members; but it is the beginning of a new approach. Projects can now be conceived in 3D space, and the details can be developed to increasing levels of coordinated complexity as the project evolves. This creates a huge potential for visualizing and communicating information that has previously only been available to persons who could “read plans.” It also allows much earlier and more accurate feedback from anyone related to the project who can understand the 3D models and does not have to read plans.

Figure 1.1.3 3D model

The goal is not simply having a BIM, but it is the project understanding generated through thecreation of the BIM, and the benefits of the use of the information that is available through the BIM.

Visualization

This relates to visualization and also points to the close connection to the word understanding.

The clearest benefit from a 3D model is the improved ability to visualize (understand) what is being represented. Many persons have difficulty understanding 2D drawings; yes, even those who pride themselves in this skill are sometimes surprised when, after studying drawings intently, something suddenly becomes clear. A 3D model, however, clearly represents the project and allows the visualization of many of its features, even with surprisingly few details. The human brain excels inits ability to abstract and to understand through the use of abstractions. Symbols are a powerful wayto convey a lot of meaning with very minimal information. Humans have to be able to visualize something (an object or an idea) to communicate it and to understand something to visualize it. The visualization actually is an abstraction of the object or idea; it is not seen or understood in all its intricate detail at once—the significant features seem to be in focus, while the rest appears fuzzy This implies that each person may focus on slightly different characteristics to compose thevisualization of the object or idea; and it is this difference that is most often the cause ofmisunderstandings between persons attempting to communicate. Humans also have varying ability tolearn how to visualize; but even with a lot of ability "a picture is worth a thousand words." And if apicture is worth a thousand words, then how much will a 3D model be worth, or a movie of a timedsequence of events? Thus, it helps to develop a visualization (and understanding) through the use ofa model that represents far more information and details than can be contained in the visualization ofmost individuals.

An integral part of visualization is the ability to access the right information in the correct format, sothat it can be "seen" in the context of the whole project. The possibility to use the BIM as a central depository (or link) for much of the project information is promising. Just this feature alone could revolutionize information management for a project. The model may enable better access to project information and thus improve project understanding and control, and become a powerful management tool. The model was made in Constructor and rendered in 2D,Revit architecture 3D.

BIM implementation

The BIM is implemented in the reverse order of the planning of the implementation. The projectteam will be brought together first, based on the plan; then the processes will be implemented and adjusted accordingly, after which the deliverables can be produced. This has strong similarities to themethod used by a structural engineer to calculate a structure by starting at the highest level and working down to the foundation, while clearly the constructor will begin by building the foundation and continue erecting the structure from the bottom up. In reality, good planning will include several back-and-forth journeys along such a path. Each trip up or down this planning sequence will generate information that will allow certain changes and adjustments to be made that help to refine the result. This also parallels the information feedback loop upon which much of BIM development is based. It

is helpful to begin the BIM application to projects on a manageable scale. Most project teams will find it challenging to have access to enough persons with enough skills to get very deeply into the BIM approach in the beginning. It is, however, extremely useful and productive for a project to have these methods implemented at any level, and care should be given to developing a comfortable level of application for the given project and project team.

II. Literature

1. Alexander Vysotskiy, Sergei Makarov, Julia Zolotova, Eugenia Tuchkevich says Step by step all companies are moving to BIM technology now days. It accelerates work and makes efforts of designers more effectives. Unfortunately, it is not so easy. Aim of this article is to provide specialists that a moving to BIM technologies with required practical recommendations. BIM implementation is a complicated process. If you want to avoid mistakes and get great benefits from the integration authors advice you to take into account recommendation listed in this article.
2. Dr.Peter Smith: This paper examines the issues related to the implementation of Building Information Modeling (BIM) in the construction industry and the various initiatives and approaches that are bring used in various countries around the world to promote effective BIM implementation in their construction industries. BIM implementation is rapidly growing in the global construction industry, driven by government mandates and private sector recognition of its benefits. Early investment in BIM capabilities is crucial for firms to stay competitive, but financial constraints pose a challenge. The shift towards BIM adoption is now evident, with leading firms setting innovative standards. Lagging firms must adapt their practices, as the longer they delay, the more their competitors gain an edge. In a globalized market, firms need strong BIM expertise to complete against both local and international rivals. Developing BIM capabilities offers a strategic advantage in a filed still dominated by firms lacking in this area.
3. Dr. Peter Smith: This paper focuses on Quality of the BIM Model, Automated Quantities, Lack of Standards/Software Incompatibility, Sharing Cost Data Information, Business Changes, Legal/Contractual/Insurance Issues
4. James Garbetta, Thomas Hartleya, David Heesomb concluded that Augmented reality (AR) is fast becoming an established tool for the construction industry. Collaborative methods of working is becoming critical to the success of the construction sector. BIM is supporting the move to this collaborative reactive method of working and exchanging digital data. The research question identified in this study focused on under- standing whether the concept of real time, interactive, collaborative AR can provide an effective and valuable tool to support workflows within a distributed construction team. The research question identified in this study focused on under- standing whether

the concept of real time, interactive, collaborative AR can provide an effective and valuable tool to support workflows within a distributed construction team. Future work will seek to further develop and enhance this BIM-AR platform in respect to emerging hardware thus removing the need for AR to be viewed through mobile devices.

5. Srimathi. S discussed the Building Information Modeling (BIM) is a software technology used to efficiently plan, design, construct and manage buildings and infrastructure for Architecture, Engineering and Construction (AEC) professionals. The object-oriented parametric models in BIM represent the objects by both physical and functional parameters. 2.BIM creates competency and also help users to get several benefits. It reflects the fact that users of all levels could see BIM as helping them work better, but cost savings are more likely to be realized by experienced users. The top- rated business benefits are: Visual Access to Building Information, Enables Easy Conflict Resolutions, Helps to Schedule the Construction Process, Supports Lean Construction, Helps to Manage the Involved Costs and Allows Improved Coordination and Better Management.

III. Case Study

- Location-Proposed residential building plan on plot P.No.03 IN S. 74/2/1, OR Nandur dasak shiwar Nashik
- Area of plot-276.75m^2
- Floor space index (FSI)-0.9986
- Building-G+5
- Net plot area-276.75m^2
- Total Flat-8 no
- Total Built-up area

Table 5.1 Total Built-up area statement

Built-up area statement	
Floor no	Total Built-up area(m^2)
Ground floor	15.29
First floor	143.23
Second floor	143.23
Third floor	143.23
Fourth floor	143.23

Fifth floor	143.23
Total built-up area	731.44

- Staircase-
- Trade-250mm Riser-180mm
- Clear cover

Table 5.2. Clear Cover

Footing	5omm
Column	40mm
Slab	20mm
Beam	25mm

- Built-up area with reference to basic F.S.I as per front as per front road width (Sr.no 5xbasic FSI 1.1)
- Total entitlement of FSI is the proposal-732.49
- Deshuttering period shall not be less than

Table 5.3 Deshuttering period shall not be less than

➢ Vertical face of column beams and walls	➢ 28 hours
➢ Slab spaningupto 3.50m	➢ 7 days
➢ Slab spaning over 3.50m	➢ 14 days
➢ Beams	➢ 21 days

IV. Conclusions

1. Incorporating BIM technology such as Revit Structure improves project efficiency and accuracy. Its collaborative features enhance communication and coordination among team members for optimal results.

2.Overall, Revit vastly simplifies the process of creating construction documentation by allowing users

to automatically generate 2D drawings from the 3D model. This streamlines the workflow and eliminates the need for manual drafting, saving time and ensuring accuracy. Additionally, Revit's ability to create detailed plans, elevations, sections, and schedules directly from the model helps to improve communication and coordination among project stakeholders.

3.Revit Structure enhances structural design efficiency and collaboration through comprehensive BIM technology.

4. Utilize the advanced clash detection features in Navisworks to accurately identify and resolve clashes in the BIM model

5. Quantities can be accurately calculated and managed with ease using Revit Architecture.

6. Revit Structure offers a convenient and efficient way to prepare Bar bending schedule (BBS) by accurately tracking and documenting rebar details directly from the model, making the process quicker and more accurate.

7.BIM Optimizes costs, resource use, and procurement

8.It enables real time collaboration through cloud platforms

9. It enhances project management with scheduling

References

1. Wong, A., Wong, F. & Nadeem, A. (2009), Comparative Roles of Major Stakeholders for the Implementation of BIM in Various Countries, Hong Kong Polytechnic University.
2. Olatunji, O., Sher, W., Gu,N. (2010), Building information modeling and quantity surveying practice, Emirates Journal for Engineering Research, Vol. 15, Issue 1, p. 67-70
3. Cheunga, F., Rihana , J. Taha, J., Duceb, D. &Kurula, E. (2012), Early stage multi-level cost estimation for schematic BIM models, November 2012, Volume 27, Pages 67–77
4. Building Smart (2011), A National Strategy for the Adoption & Implementation of BIM, Building Smart Australasia, Sydney
5. K.E. Ammari, A. Hammad, Collaborative BIM-based markerless mixed reality framework for facilities maintenance, in: Computing in Civil and Building Engineering, 2014, pp. 657–664, https://doi.org/10.1061/9780784413616.082.
6. L. Carozza, E. Valero, F. Bosch´e, G. Banfill, R. Mall, M. Nguyen, UrbanPlanAR: BIM mobile visualisation in urban environments with occlusion-aware augmented reality, in: Lean and Computing in Construction Congress - Joint Conference on Computing in Construction, 2017, pp. 229–236, https://doi.org/10.24928/jc3- 2017/0152.

7. J. Delgado, L. Oyedele, P. Demian, T. Beach, A research agenda for augmented and virtual reality in architecture, engineering and construction, Adv. Eng. Inform. 45 (2020), https://doi.org/10.1016/j.aei.2020.101122.

8. Azhar, S., Khalfan, M., Maqsood, T., 2012]. Building information modelling (BIM): now and beyond. Constr. Econ. Build. 12 (4), 15–28. Babic, ˇ N.C., ˇ Podbreznik, P., Rebolj, D., 2010]. Integrating r

9. A.A. Latiffi, S. Mohd, N. Kasim, M.S. Fathi, Building Information Modeling (BIM) Application in Malaysian Construction Industry, International Journal of Construction Engineering and Management, 2, 2013, pp. 1-6.

10. Z. Ma, Z. Wei, W. Song, Z. Lou, Application and extension of the IFC standard in construction cost estimating for tendering in China, Automation in Construction, 20, 2011, pp.196-204.

11. R.P. Marble, Operationalizing the implementation puzzle: an argument for eclecticism in research and in practice, European Journal of Information Systems, 9, 2000, pp. 132-147.

12.]R. Eadie, H. Odeyinka, M. Browne, C. McKeown, M. Yohanis, Building Information Modelling Adoption: An Analysis of the Barriers to Implementation, Journal of Engineering and Architecture, 2, 2014, pp. 77-101.

13. J. Rogers, H.-Y. Chong, C. Preece, Adoption of Building Information Modelling technology (BIM) Perspectives from Malaysian engineering consulting services firms, Engineering, Construction and Architectural Management, 22, 2015, pp. 424-445

14. M. Harris, A.I.C. Ani, A.T. Haron, A.H. Husain, The way forward for Building Information Modelling (BIM) for contractors in Malaysia, Malaysian Construction Research Journal, 15, 2014, pp. 1-