

# Building information modeling in site management construction essay



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The construction industry is ever evolving with increasing performance demand. Project handover deadlines are shorter, costs are tighter, regulation more stringent, project briefs are more complex, construction procurement methods more varied, Technology forever developing, parallel to technology quality more difficult to achieve and maintain. How do we, as construction professionals, respond to these increasing demands and retain implementing quality in an environment of such increasing complexity and competing constrain? The purpose is to deconstruct the process of managing construction site to investigate how a BIM approach to design and development as well as documentation might assist us to meet the future demands of implementation and site management practice. I will try to focus on present techniques used and successfully implemented examples, especially with the help of BIM tools to assist the process of site management. This report will show an outline methodology in regard to the site management work flow in practice. Particular emphasis will be placed upon the fast track nature of site implementation that is becoming more commonplace in the construction industry. These approaches, supported by property developed and implemented standard and procedures will assist to maximize the efficiency of our practice's workflow as well as clarify some myths under the increasing pressure of contemporary site management.

Keywords: BIM, Construction, Site Management, Site implementation, collision.

## **Background**

### **Industrial Context**

Managing site is a process that consists of the building or assembling of infrastructure. Far from being a single activity, large scale construction is a feat of human multitasking. Normally, the job is managed by a project manager, and supervised by a construction manager, design engineer, construction engineer or project architect. For the successful management and execution of a construction project, effective planning and technical supports are essential. Involved with the design and execution of the infrastructure in question must consider the environmental impact of the work, the successful scheduling, budgeting, construction site safety, availability of building materials, logistics, inconvenience to the public caused by construction delays and bidding, etc. Participants in the whole managing process are constantly challenged to deliver successful projects despite tight budgets, limited manpower, accelerated schedules, and limited or conflicting information. The BIM concept envisages virtual construction of a facility prior to its actual physical construction, in order to reduce uncertainty, improve safety, work out problems, and simulate and analyze potential impacts.[1]Sub-contractors from every trade can input critical information into the model before beginning construction, with opportunities to pre-fabricate or pre-assemble some systems off-site.

### **Problem**

Of course, BIM is an absolutely wonderful tool, and it has great potential to streamline costs, processes and time, to help different disciplines communicate effectively and to ensure little confusion on a construction site.

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But to get to that promised land of benefits, you have to pass through the wilderness of adoption, which always seems to hinge on organizational change, not technology. This is the inconvenient truth. Without having a clear concept and following some myths, BIM has become another cost, instead of a cost-savings tool for site management.

## **Learning Objectives:**

What is BIM?

What is virtual construction and how it helps to manage site?

What is BIM 3D to 6D approaches for construction site management?

How BIM collaborate all contractor works in a single platform to the project from collision?

## **Approach**

Masters(ConREM) Course materials of Product Modeling, literatures, recent real estate journals, Conference Lectures of world renowned practicing BIM experts and site managers of these days were my key features for investigation and analysis of this discussion topic.

Course materials were well organized and highly informative to understand BIM and personally I have used 2D / 3D CAD for more than 2 years and have had the opportunity to work in a largest construction site (satellite city) in Bangladesh as a Project Engineer in my professional career.

## **Analysis**

What is BIM?

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Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.[2]For the professionals involved in a project, BIM enables a virtual information model to be handed from the design team (architects, surveyors, civil, structural and building services engineers, etc.) to the main contractor and subcontractors and then on to the owner/operator; each professional adds discipline-specific knowledge to the single shared model. This reduces information losses that traditionally occurred when a new team takes 'ownership' of the project, and provides more extensive information to owners of complex structures. BIM can be used to demonstrate the entire building life cycle, supporting processes including cost management, construction management, project management and facility operation. Quantities and shared properties of materials can be extracted easily. Scopes of work can be isolated and defined. Systems, assemblies and sequences can be shown in a relative scale with the entire facility or group of facilities. Dynamic information about the building, such as sensor measurements and control signals from the building systems, can also be incorporated within BIM to support analysis of building operation and maintenance.[3]BIM also prevents errors by enabling conflict or 'clash detection' whereby the computer model visually highlights to the team where parts of the building (e. g.: structural frame and building services pipes or ducts) may wrongly intersect.

## **Features of BIM in site management**

One of the features of BIM in site management is Virtual design and construction. Virtual Design and Construction is the use of integrated multi-disciplinary performance models of design-construction projects to support explicit and public business objectives. Virtual models are virtual because they show computer-based descriptions of the project. The Virtual project model emphasizes those aspects of the project that can be designed and managed, i. e., the product (typically a building or plant), the organization that will define, design, construct and operate it, and the process that the site management teams will follow. These models are logically integrated in the sense that they all can access shared data, and if a user highlights or changes an aspect of one, the integrated models can highlight or change the dependent aspects of related models. The models are multi-disciplinary in the sense that they represent the Architect, Engineering, Contractor (AEC) and Owner of the project, as well as relevant sub disciplines. The models are performance models in the sense that they predict some aspects of project performance, track many that are relevant, and can show predicted and measured performance in relationship to stated project performance objectives.

### **3D – Model**

Model walkthroughs: These provide a great visualization tool enabling designers and contractors to work together to identify and resolve problems with the help of the model before walking on-site.

Clash detection: Traditionally design drawings must be coordinated to assure that different building systems do not clash and can actually be constructed  
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in the allowed space. Accordingly, most clashes are identified when the contractor receives the design drawings and everyone is on-site and working. With clashes being detected so late, delay is caused and decisions need to be made very quickly in order to provide a solution. BIM enables potential problems to be identified early in the design phase and resolved before construction begins. Illustrating the advantages of BIM, one project for the General Services Administration in America saw BIM model reviewers find 257 constructability issues and 7, 213 conflicts. On the same project, traditional plan reviewers found six constructability issues and one conflict.

**Project visualization:** Simple schedule simulation can show the owner what the building will look like as construction progresses. This provides a very useful and successful marketing tool for all those involved in a project. Contractors can also use project visualization to understand how the building will come together.

**Virtual mock-up models:** Often on large projects the owner will request physical mock-up models so they can visualize, better understand and make decisions about the aesthetics and the functionality of part of the project. BIM modeling enables virtual mock-ups to be made and tested for a fraction of the cost.

**Prefabrication:** The level of construction information in a BIM model means that prefabrication can be utilized with greater assurance that prefabricated components will fit once on-site. As a result, more construction work can be performed offsite, cost efficiently, in controlled factory conditions and then efficiently installed.

## **4D – Time**

Construction planning and management: BIM models provide a means of verifying site logistics and yard operations by including tools to visually depict the space utilization of the job site throughout a project's construction. The model can include temporary components such as cranes, Lorries and fencing. Traffic access routes for lorries, cranes, lifts, and other large items can also be incorporated into the model as part of the logistics plan. Tools can further be used to enhance the planning and monitoring of health and safety precautions needed on-site as the project progresses.

Schedule visualization: By watching the schedule visualization, project members will be able to make sound decisions based upon multiple sources of accurate real-time information. Within the BIM model a chart can be used to show the critical path and visually show the dependency of some sequences on others. As the design is changed, advanced BIM models will be able to automatically identify those changes that will affect the critical path and indicate what their corresponding impact will be on the overall delivery of the project.

## **5D – Cost**

Quantity Takeoffs: To determine a project's construction cost and requirements, contractors traditionally perform material 'take-offs' manually, a process fraught with the potential for error. With BIM, the model includes information that allows a contractor to accurately and rapidly generate an array of essential estimating information, such as materials quantities and costs, size and area estimates, and productivity projections.



As changes are made, estimating information automatically adjusts, allowing greater contractor productivity.

‘ Real Time’ cost estimating: In a BIM model cost data can be added to each object enabling the model to automatically calculate a rough estimate of material costs. This provides a valuable tool for designers, enabling them to conduct value engineering. However, it should be noted that overall project pricing would still require the expertise of a cost estimator.

## **6D – Facilities Management**

Lifecycle management: Where a model is created by the designer and updated throughout the construction phase, it will have the capacity to become an ‘ as built’ model, which also can be turned over to the owner. The model will be able to contain all of the specifications, operation and maintenance (O&M) manuals and warranty information, useful for future maintenance. This eliminates the problems that can currently be experienced if the O&M manual has been misplaced or is kept at a remote location.

Data Capture: Sensors can feed back and record data relevant to the operation phase of a building, enabling BIM to be used to model and evaluate energy efficiency, monitor a building’s life cycle costs and optimize its cost efficiency. It also enables the owner to evaluate the cost-effectiveness of any proposed upgrades.

## **Project communication and Collaboration**

Communication is essential to integrated site management processes.

Without tools that simplify communication and allow the decision maker to make timely decisions, it is difficult to minimize errors and keep everyone in the loop. A collaborative approach by BIM to project communications is the best way to minimize problems. In an integrated process, it is the only way. Different BIM models ideally, a construction project would utilize a single BIM model used by designers, contractors, subcontractors and fabricators for all purposes. Each party could access the model at will, adding content that all others could immediately utilize. The reality is that for many years there will rarely be a single BIM model. The architect may have its design model, each engineer may have an analysis model for its discipline, and the contractor may have a construction simulation model and the fabricator its shop drawing or fabrication model. Interoperability – the sharing of information between these different models – is critical to the collaborative use of BIM, by assuring that each model consistently represents the same building. However, current technologies, and levels of BIM adoption, do not yet allow seamless coordination between different BIM models. The use of multiple models undermines the collaborative use of BIM and prevents project parties from reaping the full benefits of BIM's capabilities.

Identify Collisions before They Cause Issues in the Field: Here's an example of how BIM can dramatically reduce construction cost overruns. KAI was providing BIM services for a large hospital project already under construction. When the managers integrated the MEP, HVAC and fire protection drawings into BIM model, they detected a potential collision

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between the electrical cable raceways and the HVAC. Then they met with the owner, the designer and the affected contractors to review the 3-D BIM model and work out the best solution for co-locating the raceways and the HVAC. The three-hour meeting saved thousands of dollars in change orders and weeks of potential construction delays.

In addition to collision detection, BIM enables the cost-saving power of reusability. For example, for health-care portfolio, they developed standard hospital room types in our BIM system that they continuously adapt for standard components, such as wall and bathroom designs. That allows them to build quickly and keep costs competitive. BIM also makes more off-site fabrication possible.

BIM's benefits for general contractors include higher quality work completed on a faster schedule, better design visualization, ability to clarify and control scope of work, more detailed scheduling and phasing, more accurate estimates and quantity takeoffs, improved spatial coordination and, of course, better collision detection.

## **Results and Business Impacts**

### **Key Findings**

BIM – building information modelling is a co-ordinated set of processes, supported by technology, that add value by creating, managing and sharing the properties of an asset throughout its lifecycle. BIM incorporates data physical, commercial, environmental, and operational on every element of a development's design.

### Better outcomes through collaboration

All project partners – different design disciplines, the customer, contractor, specialists and suppliers – use a single, shared 3D model, cultivating collaborative working relationships. This ensures everyone is focused on achieving best value, from project inception to eventual decommissioning.

### Enhanced performance

BIM makes possible swift and accurate comparison of different design options, enabling development of more efficient, cost-effective and sustainable solutions.

### Optimised solutions

Through deployment of new generative modelling technologies, solutions can be cost-effectively optimised against agreed parameters.

### Greater predictability

Projects can be visualised at an early stage, giving owners and operators a clear idea of design intent and allowing them to modify the design to achieve the outcomes they want. In advance of construction, BIM also enables the project team to 'build' the project in a virtual environment, rehearsing complex procedures, optimising temporary works designs and planning procurement of materials, equipment and manpower.

### Faster project delivery

Time savings, up to 50%, can be achieved by agreeing the design concept early in project development to eliminate late stage design changes; using standard design elements when practicable; resolving complex construction details before the project goes on site; avoiding clashes; taking advantage of intelligence and automation within the model to check design integrity and estimate quantities; producing fabrication and construction drawings from the model; and using data to control construction equipment.

#### Reduced safety risk

Crowd behaviour and fire modelling capability enable designs to be optimised for public safety. Asset managers can use the 3D model to enhance operational safety. Contractors can minimise construction risks by reviewing complex details or procedures before going on site.

#### Fits first time

Integrating multidisciplinary design inputs using a single 3D model allows interface issues to be identified and resolved in advance of construction, eliminating the cost and time impacts of redesign. The model also enables new and existing assets to be integrated seamlessly.

#### Reduced waste

Exact quantity take-offs mean that materials are not over-ordered. Precise programme scheduling enables just-in-time delivery of materials and equipment, reducing potential for damage. Use of BIM for automated fabrication of equipment and components enables more efficient materials handling and waste recovery.

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## Whole life asset management

BIM models contain product information that assists with commissioning, operation and maintenance activities – for example sequences for start-up and shut-down, interactive 3D diagrams showing how to take apart and reassemble equipment items and specifications allowing replacement parts to be ordered.

## Continual improvement

Members of the project team can feed back information about the performance of processes and items of equipment, driving improvements on subsequent projects

## **Business Impact**

BIM is the future of construction and long term facility management but there is still much confusion about what exactly it is and how it should be utilized and implemented. BIM is a relatively new technology in an industry typically slow to adopt change. Yet many early adopters are confident that BIM will grow to play an even more crucial role in building documentation.

BIM provides the potential for a virtual information model to be handed from Design Team (architects, surveyors, consulting engineers, and others) to Contractor and Subcontractors and then to the Owner, each adding their own additional discipline-specific knowledge and tracking of changes to the single model. The result greatly reduces information losses in transfer. It also prevents errors made at the different stages of development/construction by allowing the use of conflict detection where the model actually informs the

team about parts of the building in conflict or clashing. It also offers detailed computer visualization of each part in relation to the total building.

## **Conclusion**

BIM is much more than an electronic drawing tool. In a nutshell, BIM is the creation of a complete digital representation of all stages of the building process in order to facilitate the exchange of project information in a digital format. Driven by an information-rich database, it enables members of the project team to simulate the structure and all of its systems in three dimensions and to share this information. The drawings, specifications and construction details are integral to the model. As a result, the team members are able to identify design issues and construction conflicts well before the first earth mover arrives at the site. A project can realize its greatest potential and highest value when it is collaboratively designed and built that is, when the entire design team works together starting in the early planning and design phase. When effectively used by all key members of a project team the architecture/engineering firm (A/E), general contractor or construction manager, and specialty contractors, in particular, the mechanical, electrical, plumbing and fire protection contractors BIM is a platform for true collaboration. In fact, input from the mechanical, electrical, plumbing and fire protection contractors in the design phase is critically important to prevent collisions or conflicts in the field.

## **Practical Tips and Key Lessons:**

Virtual modeling by BIM

3D to 6D approach

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Cost saving

More organized site management

Prediction of site problems

Collaboration of site works

Well scheduled management of site

## **Acknowledgements**

I would like to thank my BIM course tutor Janne Salin (part time lecturer, ConREM) and Päivi Jävänä (teacher, ConREM) for providing me helpful information in the field of Building Information Modeling.