Introduction to Building Information System in Construction Industry

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Abstract - **Building Information Modeling "BIM" is becoming a far better known established collaboration process within the Civil Engineering industry. Owners are increasingly requiring BIM services from construction managers, architects and engineering firms. Many construction firms are now investing in "BIM" technologies during bidding, preconstruction, construction and post construction. The goal of this project is to know the uses and benefits of BIM for construction managers and examine BIM based scheduling. There are two objectives to the present project. First is to spot the present uses of BIM within the Architectural / Engineering / Construction / Facility Management industry to raised understand how the BIM-based "build to design" and "design to build" concepts are often employed by construction managers under the development Management in danger project delivery system. Second, attention is placed on analyzing 3D and 4D BIM also as BIM based scheduling.**

Keywords* — *BIM, modeling, construction, quality management, civil engineering, education, concept, technology, software.

I. INTRODUCTION

Civil Engineers have a task across the whole life cycle of assets, from project inception and delivery, to operations and eventual decommissioning. At each stage, engineers believe robust information to support multi-disciplinary deciding and inform activities, whether design, construction or maintenance. Building Information Modelling (BIM) has been high on the agenda of all organizations involved within the planning, design, construction, ownership and maintenance of the built environment in recent years, influenced significantly by government policy. Advocated because the catalyst for solving many of the industry's shortcomings including quality, collaboration and productivity, BIM is swiftly moving from a distinct segment technology-based concept to the idea for the delivery of projects and asset management across all sectors of the development industry.

With all this enthusiasm and hype, the message for what 'BIM' actually means has the potential to become confused and lost.

The core principle of BIM complements the life cycle role of civil and structural engineers; that information is made and structured on make reuse by others, whether through collaborating with other disciplines to deliver a specific task, or to support activities on make it available for reuse by others in subsequent phases of the asset's lifecycle.

This BSI whitepaper provides a high level overview of BIM for Civil and Structural Engineers. As are going to be explored throughout, BIM has many various meanings to different roles across the lifecycle of assets. We seek to offer practical, concise guidance on what we mean once we mention BIM and the way it impacts the role of civil and structural engineers.

Unfortunately, given the varied perspectives and uses of BIM and thus the various roles of engineers, this whitepaper won't provide any solution for how to 'do BIM', it's instead intended to provide an introduction to variety of the common terms and a piece of writing to navigate this fast-moving field. Throughout this guide we'll simply use the acronym 'BIM', later sections will explore differences in definition between Building Information Modelling and Better Information Management, with an article on how this fits into the broader Digital Built Britain strategy 1, a part of the economic strategy for the development sector.

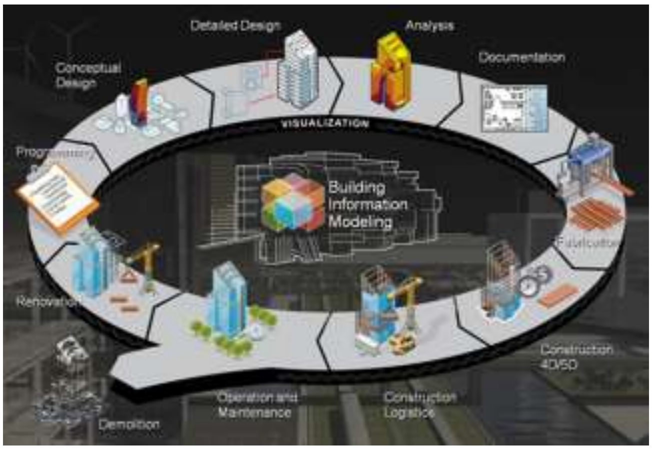

Fig. 1 Building Information Modeling

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II. BACKGROUND

That people complain of problems together and poor quality information is nothing new the development industry. It's been a daily argument of industry discourse since a 1965 Tavistock Institute report which stated:

'The basic conditions of construction control are often incomplete or unduly rushed because necessary information isn't available sufficiently before time, or isn't complete enough.' (Higgin & Jessop, 1965, p. 77)

These concerns surfaced again through the influential Latham (1994) and Egan (1998) reports. The 2002 Accelerating Change report highlighted the chance offered by Information Technologies to drive better value through an integrated team.

This culminated with the 2011 Government Construction Strategy which announced that BIM would be a requirement for all Government projects from 2016.

The origins of BIM are often dated back to the 1960s with the definition of a Building Description System. The vision was to make an entire virtual representation of a building within a computing system. Unlike traditional Computer-Aided Draughting (CAD), which uses lines to represent the

Building's features, the BIM approach uses virtual objects which have attributed properties to explain its geometry, materials, performance requirements, etc.

Through the emergence of the planet Wide Web within the 1990s, the utilization of web-based document management systems became common, with distributed teams ready to collaborate electronically without having to believe the mail to share documents and drawings. Document management systems became sophisticated, embedding processes to support contract management, quality assurance and technical queries, and as result became referred to as Common Data Environments.

The combination of the Building Information Model with a standard Data Environment became referred to as Building Information Modelling, or 'BIM' for brief. To realize the utmost benefits, projects needed to adopt processes for specifying the knowledge uses, standards, software, hardware and management systems, prescribed through a BIM Execution Plan.

Following this, asset owners and operators recognized that projects represent only a fraction of the life cycle of their assets. Asset Information and Facility Management Systems, the databases and processes which support the operation of facilities, should be ready to ask projects, consume information and transition smoothly between asset lifecycle stages through a digital information exchange, instead of a delivery of box files or DVDs filled with unstructured data.

This results in three views of BIM, supported the scope of these implementing it:

• BIM as a technology supporting a task within the project, like the utilization of simulation to verify construction schedules;

• BIM as a project delivery methodology facilitating the delivery of a project by providing a way of collaboration between all project team members, providing project information within the right format for those that need it;

• BIM as a lifecycle asset and facility management approach to the creation and exploitation of data supporting operations, maintenance and deciding also as optimizing the project phase.

Although led, technologically, by the buildings sectors, there are samples of BIM applied to all or any construction project types. As are going to be detailed in later sections BIM is being leveraged across the built environment resulting in smart facilities and asset management and unlocking the chance of other digital trends like Smart Cities.

III. BIM TOOLS

There are many Building Information Modeling tools. This subsection will identify these products. The subsequent table, figure 8, depicts the BIM authoring tools and their primary functions. The list includes MEP, structural, architectural, and site work 3D modeling softwares. A number of these softwares also are capable of scheduling and cost estimation.

Product Name	Manufacturer	Primary Function
Cadpipe HVAC	AEC Design Group	3D HVAC Modeling
Revit Architecture	Autodesk	3D Architectural Modeling and parametric design.
AutoCAD Architecture	Autodesk	3D Architectural Modeling and parametric design.
Revit Structure	Autodesk	3D Structural Modeling and parametric design.
Revit MEP	Autodesk	3D Detailed MEP Modeling
AutoCAD MEP	Autodesk	3D MEP Modeling
AutoCAD Civil 3D	Autodesk	Site Development
Cadpipe Commercial Pipe	AEC Design Group	3D Pipe Modeling
Dprofiler	Beck Technology	3D conceptual modeling with realtime cost estimating.
Bentley BIM Suite (Micro Station, Bentley Architecture, Structural, Mechanical, Electrical, Generative Design)	Bentley Systems	3D Architectural, Structural, Mechanical, Electrical, and Generative Components Modeling
Fastrak		
SDS/2	Design Data	3D Detailed Structural Modeling

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Fabrication for AutoCAD MEP	East Coast CAD/CAM	3D Detailed MEP Modeling
Digital Project	Gehry Technologies	CATIA based BIM System for Architectural, Design, Engineering, and Construction Modeling
Digital Project MEP Systems Routing	Gehry Technologies	MEP Design
ArchiCAD	Graphisoft	3D Architectural Modeling
MEP Modeler	Graphisoft	3D MEP Modeling
HydraCAD	Hydratec	3D Fire Sprinkler Design and Modeling
AutoSPRINK VR	M.E.P. CAD	3D Fire Sprinkler Design and Modeling
FireCad	3D Detailed MEP Modeling	Fire Piping Network Design and Modeling
CAD-Duct	Micro Application	3D Detailed MEP Modeling
Vectorworks Designer	Nemetschek	3D Architectural Modeling
Duct Designer 3D, Pipe Designer 3D	QuickPen International	3D Detailed MEP Modeling
RISA	RISA Technologies	Full suite of 2D and 3D Structural Design Applications
Tekla Structures	Tekla	3D Detailed Structural Modeling
Affinity	Trelligence	3D Model Application for early concept design
Vico Ofice	Vico Software	5D Modeling which can be used to
PowerCivil	Bentley Systems	generate cost and schedule data
Site Design, Site Planning	Eagle Point	Site Development

Table No. 1 BIM Authoring Tools

A variety of shop BIM tools for drawing and fabrication are available or structural and MEP contractors as depicted as follows –

Product Name	Manufacturer	Primary Function
Cadpipe Commercial Pipe	AEC Design Group	3D Pipe Modeling
Revit MEP	Autodesk	3D Detailed MEP Modeling
SDS/2	Design Data	3D Detailed Structural Modeling
Fabrication for AutoCAD MEP	East Coast CAD/CAM	3D Detailed MEP Modeling
CAD-Duct	Micro Application Packages	3D Detailed MEP Modeling
Duct Designer 3D, Pipe Designer 3D	QuickPen International	3D Detailed MEP Modeling
Tekla Structures	Tekla	3D Detailed Structural Modeling

Table No. 2 BIM Tools for Shop drawing and Fabrication

Revit Architecture provided by Autodesk Inc. has built-in sequencing options. Each object are often assigned a phase. Revit then uses snapshots of the model for every phase creating an easy sequencing for the viewers. Currently, there are tons of architects that are using Revit Architecture. Various BIM construction management and scheduling tools are available as depicted in Below Table. BIM Construction management tools that support coordination are Navisworks Manage, ProjectWise, Digital Project Designer, and Vico. Furthermore, Vico, Navisworks Timeliner, Innovaya and Synchro support BIM and schedule integration. Navisworks, Synchro and Vico Ofice softwares are going to be discussed in further detail.

Product Name	Manufacturer	Primary Function
Navisworks Manage Navisworks Scheduling	Autodesk	Clash Detection Scheduling
ProjectWise	Bentley	Clash Detection Scheduling
Digital Project Designer	Gehry Technologies	Model Coordination
Visual Simulation	Innovaya	Scheduling
Solibri Model Checker	Solibri	Spatial Coordination
Synchro	Synchro Ltd.	Planning & Scheduling
Tekla Structures	Tekla	Structure-centric Model Schedule driven link
Vico Office	Vico Software	Coordinate Scheduling Estimating

Table No.3 BIM Construction Management and Scheduling Tools

IV. METHODOLOGY USED OF BIM IN CONSTRUCTION MANAGEMENT

There are many uses of Building Information Modeling for every project participant. depicts these uses for the design , design (preconstruction), construction and operation (post construction) phases:

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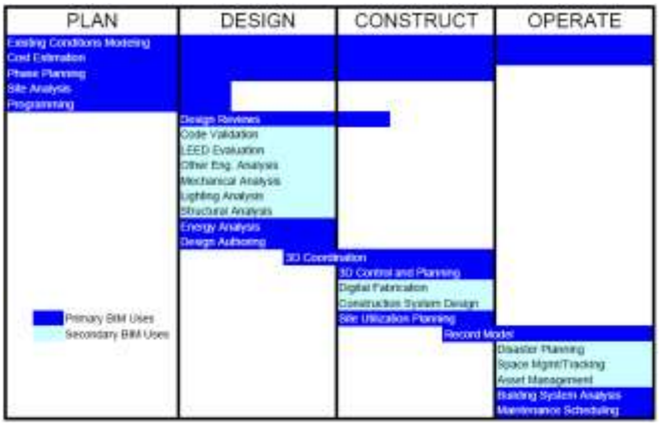

Fig. 2 Phases in Building Information Modeling

The BIM methodology involves the coordination of various technologies for project management through one 3D digital model that shortens the days of both the planning and therefore the production, and thus it reduces costs. It also implies a replacement way of coordinating the various teams involved, improving the standard of the engineering projects, architecture and construction.

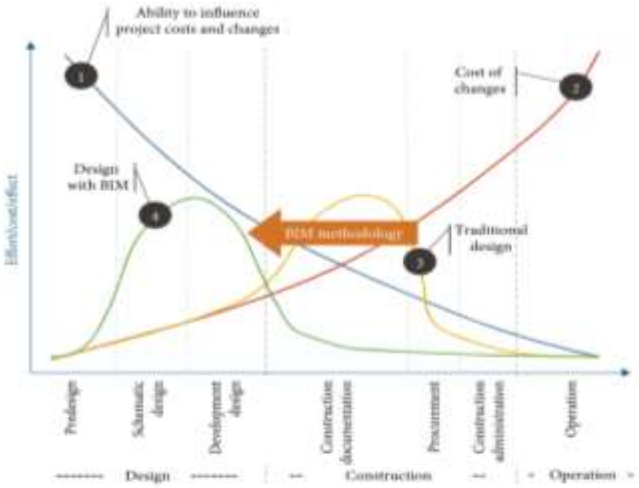

Fig. 3 Time Life Cycle of an Infrastructure / Building Project

In this graph we'll disaggregate the changes that have taken place within the working and project development methods, optimizing the method , streamlining phases of the project and achieving a more linear and collaborative workflow.

In the early stages, where the project evolves and is being generated, the BIM methodology helps us to simply extract floors and sections from one 3D model. This model is that the germ of the project and because of the varied displays, it allows the understanding of the various proposals by the customer and by our own team, and every one that in real time.

Because of the importance of the project's implementation on its place and its adaptation to the environment, is effective the knowledge we will get around the energy evaluation of the building. During this way from the initial phases comparatives of various sustainable solutions are generated, allowing us to pick the foremost appropriate from the conceptual phase. For this, we use the BIM model to review the optimum orientation of the rooms, the quantity of radiation and lower environmental impact (6D). We may, if necessary, export the model to specific tools that complement the knowledge obtained from the native model.

The coordination of the planning team begins gaining importance within the intermediate stages. From the beginning, domains and therefore the ability to switch the various design elements of every team member, should be managed. BIM model and an open environment, enables various design teams simultaneously design different parts of the project, without getting interference and expediting the method.

During the foremost advanced stages of the planning, the utilization of open standards allows the utilization of the simplest specific tools within the calculation and sizing of structures and facilities. First of all, the export to IFC of the architectural model allows engineers to import into their programs modelling and analysis for evaluation and approval by the project coordinator. Subsequently BCF file sharing enables the transmission of comments and observations also as tracking the modifications to the project that facilitates its traceability.

The IFC files also are wont to federate or integrate the various partial models of the project, and check the degree of collisions between them. By using verification tools we detect beforehand possible anomalies which will cause conflict later in work, and thus avoiding more costly changes during the execution of the work.

Some unique elements require special attention during the event of the projects. To try to to this, we will check out design options because of the utilization of parametric tools. With them we will investigate and compare intimately alternatives that allow us to settle on the foremost convenient solution for our client. These tools are wont to develop facades, finishes and even unique elements within the interior design phase through the utilization of interoperable formats we will design exclusive and unique furnishing that adds value to the proposal.

When it involves elaborate the work's documentation, the utilization of BIM methodology ensures the right coordination between the three-dimensional models (3D), the two-dimensional planes exported to varied formats (2D). Likewise, the utilization of displays of the model – with specific applications for mobile devices – allows a way more completed and updated reading of the project. This information is usually at the disposal of labor team and therefore the client. Finally, we will also export the IFC file model to measurement and budgeting programs (5D) and also simulation, planning and construction management (4D) to finish the knowledge that we will extract from the model. Once the project is made, the BIM model can still be wont to perform the great management of services and building maintenance (7D).

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The BIM methodology is certainly not a technological transformation by itself isn't a software, it's a change of mentality. Interoperability within the complex processes has become essential within the market, traceability of actions and therefore the inherent responsibilities of every participant in development is important to the graceful running of the project. Customer access to all or any information during a simple and practical way in real time, is nowadays possible and desirable.

Unlike many other disciplines within the built environment, civil and structural engineering comprises a group of skills and competencies that apply to all or any project types from minor slope strengthening and flood alleviation schemes to vast structures like tall buildings and multi-span bridges. The variability of roles that engineers take across projects means there are not any hard and fast rules about how BIM is impacting the profession. However, one that trend are often seen is that the appliance of BIM for civil and structural engineers varies along two axes. The primary is whether or not or not the client may be a department and therefore the second is whether the project may be a commercial building or transport and utility infrastructure.

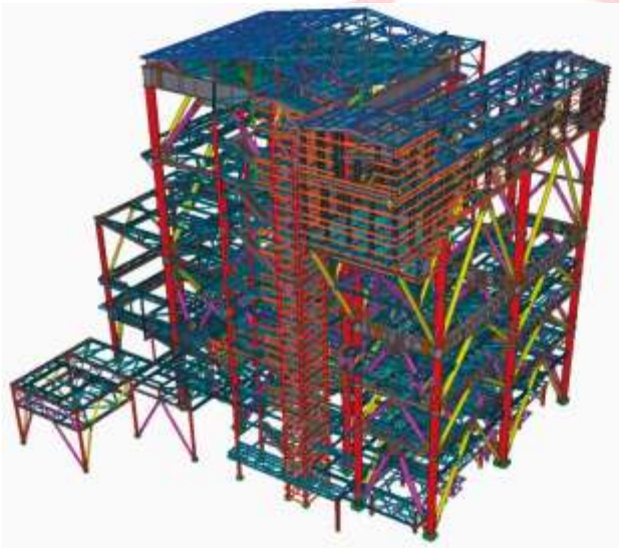

Fig. 4 Building Information Modeling

V. APPLICATIONS OF BIM IN CIVIL ENGINEERING

BIM involves all disciplines and professions involved during a project or asset management activity interacting and collaborating via one source of project information, structuring and presenting data in order that others can reuse it.

True BIM implementation requires supply chain wide adoption of the processes, technologies and skills which underpin the approach, the maturity of which varies on a sector by sector basis. Engineers should, therefore, look to their clients, colleagues and competitors to ascertain how BIM is being applied in their market sector (suggestions for where to start out are given later during this paper).

This is to not say, however, that civil and structural engineers should await supply chain peers to steer the way. There are many benefits to be gained from the adoption of BIM tools and techniques within one's own work:

• integrating analysis and drawing production to enhance efficiency;

• 3D modelling to enhance quality in terms of coordination and communication;

• A standard data environment to enhance collaboration within and across teams;

• using visualization to interact non-technical stakeholders during design reviews;

• improve confidence within the design and use the model for prefabrication;

• planning and optimizing the project schedule through simulation;

• monitoring project budgets and spend through linking activity with components;

• using the 3D model to enhance site inductions, making safety and risk management tangible;

• maintaining inspection records to watch asset performance.

Fig. 5 Building Information Modeling

- BIM Uses throughout a Building Lifecycle -

During the planning phase, the utilization of BIM can maximize its impact on a project since the power to influence cost is that the highest. The team can creatively come up with ideas and supply solutions to issues before problems become high cost impacts to the project. This will be realized through the cooperation and coordination of the whole Project staff. Therefore, it's extremely important to possess an honest collaboration. The utilization of BIM especially enhances the collaborative efforts of the team. The architect and Engineer can test their design ideas including energy analysis. The development manager can provide constructability, sequencing, value and engineering

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reports. They will also start 3D coordination between subcontractors and vendors during early stages of design.

VI. FUTURE OF BIM

The exploitation of emerging technologies, reapplication of best practice and capability within the creation and management of data will still develop.

The unbounded problem of 'what is BIM?' and its remit encroaching on many other parts of the delivery of assets has led to the term digital becoming a trendy alternative to differentiate all the opposite things we will do with new technology from the core of BIM Level 2. .

The recently formed BIM Alliance may be a cross-institutional group found out to coordinate all the activities concerning BIM Level 2. The group has an ambitious target that BIM Level 2 are going to be embedded as business as was common across 75 per cent of the development supply chain by 2022 and can still develop the guidance, standards and templates required to enable the transition to BIM to be as smooth as possible. This includes working across the buildings and infrastructure sectors to make a standard language for naming what we do in order that knowledge can travel across traditional discipline and sector-based boundaries.

VII. CONCLUSION

BIM, whether Building Information Modelling or Better Information Management, is here to remain. Civil and Structural engineers, whether involved in design, construction or maintenance, have tons to realize from the higher exploitation of technology, collaboration through information sharing and embracing good practice. Unfortunately, there are not any hard and fast rules about what BIM will involve for the individual, by its nature BIM may be a group level process and requires everyone to adopt the proper tool and process to suit both themselves and therefore the team. Owners, client organizations and suppliers can have conflicting aims, BIM requires negotiation between these parties to work out the foremost appropriate methods on a project-by-project basis. The principal factor to think about is that we not create information just to assist ourselves do our own job; we create information in order that people can find it and reuse it for his or her job too.

REFERENCES

[1] Bae, A., Lee, D., Park, B. (2015). Building information modeling utilization for optimizing milling quantity and hot mix asphalt pavement overlay quality. Canadian Journal of Civil Engineering. 43(10), 886-896. doi: 10.1139/cjce-2015-0001.

[2] Andujar-Montoya, MD. (2015). A Construction Management Framework for Mass Customisation in Traditional Construction. Sustanability. 7(5). 5182-5210. doi: 10.3390/su7055182

[3] Shen, H., Tzempelikos, A., Atzeri, A. M., Gasparella, A., & Cappelletti, F. (2014). Dynamic Commercial Façades versus Traditional Construction: Energy Performance and Comparative Analysis. Journal of Energy Engineering. 141(4), 141-147. doi: 10.1061/(ASCE)EY.1943-7897.0000225.

[4] Chong, H.-Y. (2016). the outlook of building information modeling for sustainable development. Clean Technologies and Environmental Policy. 18(6), 1877-1887. Doi: 10.1007/s10098-016-1170-7.

[5] Skandhakumar, N. (2016).Graph theory based representation of building information models for access control applications. Automation in Construction. 68(8), 44-51. doi: 10.1016/j.autcon.2016.04.001

[6] Hu, Z.-Z. (2016). Construction and facility management of large MEP projects using a multi-Scale building information model. Advances in Engineering Software. 100(10), 215-230. doi: 10.1016/j.advengsoft.2016.07.006.

[7] www.Google.com

[8] Turk, Z. (2016).Ten questions concerning building information modelling. Building and Environment. 107(10), 274-284. doi: 10.1016/j.buildenv.2016.08.001

 DOI : 10.35291/2454-9150.2020.0538