

# International Journal of Innovative Research in Science, Engineering and Technology

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## Building Information Modelling and Its Applications

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**ABSTRACT:** Traditional building design was largely reliant upon two-dimensional technical drawings (plans, elevations, sections, etc.). Building information modelling extends this beyond 3D, augmenting the three primary spatial dimensions (width, height and depth) with time as the fourth dimension and cost as the fifth. More recently there are also references to a sixth dimension (6D) representing building environmental and sustainability aspects, and a seventh dimension (7D) for through-life facility management, although there are conflicting definitions. BIM therefore covers more than just geometry. It also covers spatial relationships, light analysis, geographic information, and quantities and properties of building components (for example, manufacturers' details).

BIM involves representing a design as combinations of "objects" – vague and undefined, generic or product-specific, solid shapes or void-space oriented (like the shape of a room), that carry their geometry, relations and attributes. BIM design tools allow extraction of different views from a building model for drawing production and other uses. These different views are automatically consistent, being based on a single definition of each object instance. BIM software also defines objects parametrically; that is, the objects are defined as parameters and relations to other objects, so that if a related object is amended, dependent ones will automatically also change. Each model element can carry attributes for selecting and ordering them automatically, providing cost estimates as well as material tracking and ordering.<sup>[24]</sup>

### I. INTRODUCTION

**Building Information Modelling (BIM)** is a process involving the generation and management of digital representations of physical and functional characteristics of places. **Building Information Models (BIMs)** are files which are not always in proprietary formats and containing proprietary data which can be extracted, exchanged or networked to support decision-making regarding a building or other built asset. Current BIM software is used by individuals, businesses and government agencies who plan, design, construct, operate and maintain diverse Physical Infrastructure, such as water, refuse, electricity, gas, communication utilities, roads, railways, bridges, ports and tunnels.

Building information models span the whole concept-to-occupation time-span. To ensure efficient management of information processes throughout this span, a BIM manager (also sometimes defined as a virtual design-to-construction, VDC, project manager – VDCPM) might be appointed. The BIM manager is retained by a design build team on the client's behalf from the pre-design phase onwards to develop and to track the object-oriented BIM against predicted and measured performance objectives, supporting multi-disciplinary building information models that drive analysis, schedules, take-off and logistics. Companies are also now considering developing BIMs in various levels of detail, since depending on the application of BIM, more or less detail is needed, and there is varying modelling effort associated with generating building information models at different levels of detail.

### II. LITRATURE REVIEW

In the modern world, due to increase in globalization scale, construction industry has followed a fast pace, thus to ensure the fast and effective construction of buildings, many new applications have been implemented. One of these is

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BIM which means Building Information Modelling. In this concept the whole model of multi-storey buildings is pre-visualized and drawn and from these drawings we encounter every material and time required for completion of the Project. Many research papers are also published on the same concept which describe different applications of BIM which ensures safe and effective completion of projects. The paper given by Eastman Charles deals with further study of applications of BIM in construction site safety management.

The paper published by Hosseini, Reza also carried the research on BIM and suggested "Barriers to adoption of building information modelling (BIM) in Iran. this study helped in assisting many projects in their effective completion.

Further a German Scientist White Jack conducted research in 1986 and published a research paper to tackle problems of transportation in which BIM in mandate for transport projects was conducted in Germany which was confirmed for 2020".

### III. APPLICATIONS OF BIM

For the professionals involved in a project, BIM enables a virtual information model to be handed from the design team (architects, landscape 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 data 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.

### IV. BIM IN CONSTRUCTION MANAGEMENT

Participants in the building process are constantly challenged to deliver successful projects despite tight budgets, limited manpower, accelerated schedules, and limited or conflicting information. The significant disciplines such as architectural, structural and MEP designs should be well coordinated, as two things can't take place at the same place and time. Building Information Modelling aids in collision detection at the initial stage, identifying the exact location of discrepancies.

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 analyse potential impacts.<sup>[28]</sup> 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. Waste can be minimised on-site and products delivered on a just-in-time basis rather than being stock-piled on-site.<sup>[28]</sup>

Quantities and shared properties of materials can be extracted easily. Scopes of work can be isolated and defined.



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Systems, assemblies and sequences can be shown in a relative scale with the entire facility or group of facilities. 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.

## V. BIM IN FACILITY OPERATION

BIM can bridge the information loss associated with handling a project from design team, to construction team and to building owner/operator, by allowing each group to add to and reference back to all information they acquire during their period of contribution to the BIM model. This can yield benefits to the facility owner or operator.

For example, a building owner may find evidence of a leak in his building. Rather than exploring the physical building, he may turn to the model and see that a water valve is located in the suspect location. He could also have in the model the specific valve size, manufacturer, part number, and any other

information ever researched in the past, pending adequate computing power. Such problems were initially addressed by Leite and Akinci when developing a vulnerability representation of facility contents and threats for supporting the identification of vulnerabilities in building emergencies.

Dynamic information about the building, such as sensor measurements and control signals from the building systems, can also be incorporated within BIM software to support analysis of building operation and maintenance.

There have been attempts at creating information models for older, pre-existing facilities. Approaches include referencing key metrics such as the Facility Condition Index (FCI), or using 3D laser-scanning surveys and photogrammetry techniques (both separately or in combination) to capture accurate measurements of the asset that can be used as the basis for a model. Trying to model a building constructed in, say 1927, requires numerous assumptions about design standards, building codes, construction methods, materials, etc., and is therefore more complex than building a model during design.

One of the challenges to the proper maintenance and management of existing facilities is understanding how BIM can be utilized to support a holistic understanding and implementation of building management practices and "cost of ownership" principles that support the full life cycle of a building. An American National Standard entitled *APPA 1000 – Total Cost of Ownership for Facilities Asset Management* incorporates BIM to factor in a variety of critical requirements and costs over the life-cycle of the building, including but not limited to: replacement of energy, utility, and safety systems; continual maintenance of the building exterior and interior and replacement of materials; updates to design and functionality; and recapitalization costs.

## VI. BIM IN GREEN BUILDING



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BIM in green building, or "Green BIM", is a process that can help architecture, engineering and construction firms to increase sustainability in the construction industry. It can allow architects and engineers to integrate and analyse environmental issues in their design over the life cycle of the building.

Building information modelling (BIM) using in green building has helped to enable sustainable design allowing architects and engineers to integrate and analyse building performance. Through this method, it enhances design and construction efficiency. Using these tools, designers may quantify the environmental impacts of systems and materials to support the decisions needed to design sustainable buildings, using information about sustainable materials that are stored in the database, and interoperability between the design and analysis tools that enable full life cycle assessments (LCAs) of buildings.

## VII. BIM PROVIDES CLEAR COMMUNICATION

One of the challenges in AEC industry is the trouble in communicating effectively with all parties involved in the project.

This is where BIM comes into play. The BIM model can be used to demonstrate how the design will work with greater clarity than a 2D drawing. Whoever the end-user may be (the client, contractor, public consultations), it enables us to illustrate what the scheme would look like from a variety of different angles. As a result, it removes much of the ambiguity associated with complex projects. The model enables people to visualize the size and shape of the scheme, access to it and how it will work.

## VIII. BIM PROVIDES BETTER MANAGEMENT

BIM encompasses all of the information regarding construction and dimensions thus becoming a single source of information management. This will help in managing multidisciplinary challenges from clients, stakeholders, contractors and public.

The ability to visualize the project in its entirety via a single 3D model, as well as access other intangible data incorporated into the model via BIM, radically improves coordination between the distinct parties to its development. This in turn avoids potential clashes between the various elements of the project.

### The Key Benefits of This Modelling Approach Are as Follows

- **Reduction of risks** from greater visibility into design and construction interfaces, and activity
- **Improved safety** through increased construction awareness from easy review of complex details or processes on site.
- **Reduced errors** from using a single source approach to data management, e.g. ensuring only the most appropriate version of models, drawings, and documentation is used
- **Improved collaboration** through linked data sets and integrated 3D models that create a 'virtual' world before the physical structure is constructed, allowing design and construction refinement.
- **Reduced information loss** between project phases, ensuring the capture and hand-over of full asset information into the Operations and Maintenance phases.

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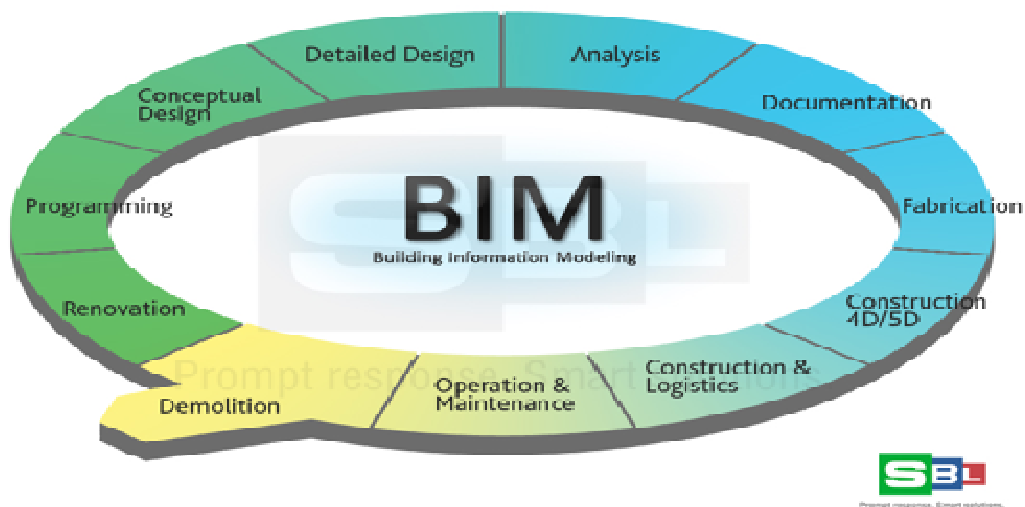
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- **Improved project delivery** leveraging technology advances that include data interoperability and mobility

### IX. CURRENT APPLICATION

**Building information modelling (BIM)** is a managed approach to the collection, creation, collation and exchange of shared intelligent and structured data and information across a project. Its use is growing exponentially across the spectrum and governments are adapting BIM standards into their management systems. Many projects have now successfully implemented BIM with significant benefits, including increased design quality, improved field productivity, cost predictability, reduced conflicts and changes, and reduced construction cost and duration to name a few. One of the areas where BIM is practiced customarily is underground railway networks. Building information modelling, or BIM, is introducing a transformational change to how infrastructure projects are delivered. The time and cost saving elements of BIM are well-documented. Whether it is the public, the client, the contractor, suppliers to the project, delivery partners or operations staff, BIM enables everyone to visualize the outcomes far better than the traditional 2D drawings.



### X. ANTICIPATED FUTURE POTENTIAL

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.

Proponents claim that BIM offers:

Improved visualization

Improved productivity due to easy retrieval of information

Increased coordination of construction documents

Embedding and linking of vital information such as vendors for specific materials, location of details and quantities required for estimation and tendering

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Increased speed of delivery

Reduced costs

BIM also contains most of the data needed for building performance analysis. The building properties in BIM can be used to automatically create the input file for building performance simulation and save a significant amount of time and effort.<sup>[90]</sup> Moreover, automation of this process reduce errors and mismatches in the building performance simulation process.

## XI. CONCLUSION

It is no secret that building information modelling (BIM) represents ground breaking technology that, as it grows, is changing the face of the construction industry. BIM provides the user with a visual perspective of project components in real time. Any stakeholder involved has access to up-to-date project data with the ability to communicate with other parties within the BIM platform. As a result, BIM empowers users to collaborate more efficiently, identify and address challenges, streamline processes from design to construction and produce faster, better, more sustainable outcomes.

In the past few years, some common themes and big questions have been revealed as BIM is implemented, or even mandated, on a global scale. But satisfactory solutions for the same were implemented by means of BIM.

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