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Consulting – Engineering – Supervision
Industrial Plants – Buildings – Infrastructure

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NEWSLETTER

THE BIM PROCESS: CONCEPTS AND APPLICATIONS TO THE CONSTRUCTION INDUSTRY

Introduction

This Newsletter edition provides an overview of the Building Information Modeling (BIM) process. This important technology has been gradually implemented at EC over the past years.

Building Information Modeling (BIM)

Building information modeling (BIM) is a process involving the generation and management of a digital representation of physical and functional characteristics of a facility.

The resulting building information model becomes a shared knowledge resource to support decision-making about a facility from earliest conceptual stages, through design and construction, then through its operational life before its eventual demolition.[1]

Why is it BIM Different?

BIM tools are as different from CAD tools, in the same way that a slide rule is different from a computer, or as a set of toy soldiers is different from a battle-oriented computer game.[2]

For all of the history, design and construction of building have relied on 2-dimensional drawings for representing the work to be done. They were defined as contracts - legal documents, were assessed by building codes, and used to manage the facility afterward. But there are two strategic limitations of 2D drawings elaborated with conventional CAD tools:

(1) Drawings require multiple views to depict a 3D object in adequate detail for construction, making them highly redundant and thus open to errors;

(2) Drawings are stored as lines, arcs and text annotations that are only interpretable by some skilled people. 3D models are easy to understand by not technically trained end users (owners, buyers).

Building Information Modeling involves representing a design as objects that carry their geometry, relations and attributes. The inclusion of parametric 3D geometry, with variable dimensions and assigned rules, adds intelligence to these objects, permitting the representation of complex geometric and functional relationships between building elements and allowing the direct transfer of information between different software environments.

For example, walls are objects which can be stretched, joined, have height, be of a specific cross-section type, and own associated properties, such as a fire rating or insulation value. Similarly, water pipes and electrical conduits are represented as objects, capable of representing their relationship to the walls in which they are placed and behaving accordingly.

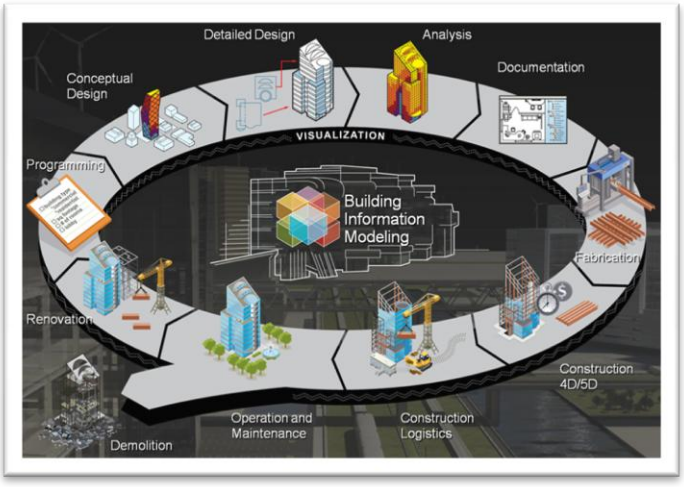

Fig. 1. A Building Information Modeling plays a key role during the entire lifecycle of a building. BIM starts as early as the initial early programming and conceptual design phases and continues throughout detail design, construction, O&M and eventual renovation/demolition.

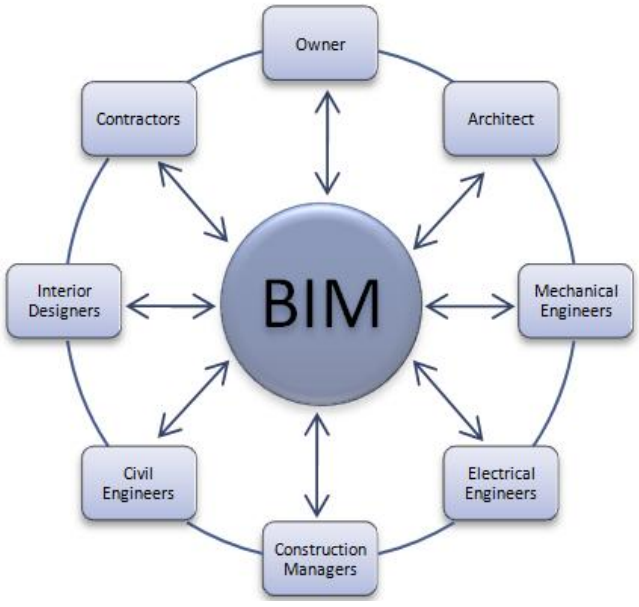

Fig. 2. A Building Information Model plays a key role for coordinating the interactions between the different design/build project stakeholders. Design-build and other forms of architect-contractor teaming have been recognized as more efficient - in terms of cost, time, and for reducing the potential for litigation.

[1] *See http://en.wikipedia.org/wiki/Building_information_modeling*

[2] *See e.g. http://es.scribd.com/doc/67271936/BIM-Aka-Building-Information-Modeling-and-Tools-Analysis#download*

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Why BIM is Important?

Because 3D objects are computer readable, spatial conflicts in a building model can be checked automatically. This capability, at both the design and shop drawing levels, greatly reduces mistakes and change orders due to internal errors caused by non-detected interferences between different systems or members.

The larger implications of BIM design are not just consistent drawings, but also cost estimation, bills of material and clash detection. Because building models are machine readable, it becomes practical to use the data they carry in many other ways: for thermal, lighting, acoustic or other analyses - not as post factor checking if an almost finished design is "OK", but rather to provide feedback while designing, informing the designer of the effects of changes or to explore the relative effect on alternatives.

The process of BIM is revolutionary because it provides the opportunity to migrate from practices that are centered on human craftsmanship to a more augmented and modern machine craftsmanship - and all that this might imply. In this sense, the introduction of BIM in the engineering and construction industry is similar to the automation of manufacturing in the 1980s, when most manufacturing industries first adopted 3D modeling and digital representations.

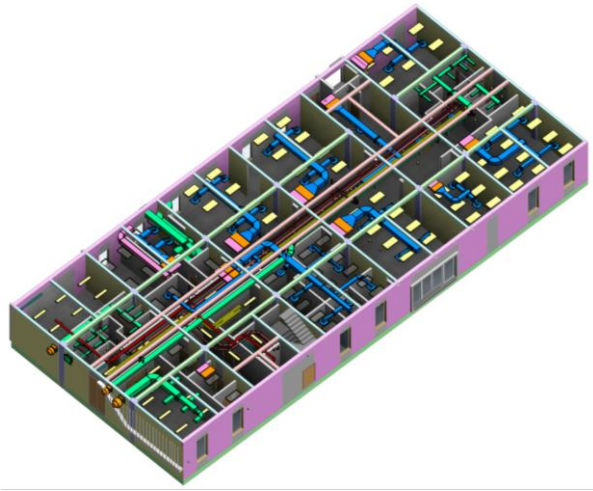

Fig.3: Example of a building service equipment and supply lines of a hotel building. A 3D model is easier for all parties to interpret and visualize. Design or fabrication work can be coordinated in person or at a distance using web conferencing and virtually walking through the 3D model

BIM applications on Facility Management

BIM brings to owners a robust operations and maintenance tool for their long-term facilities needs. When BIM is provided as a fully accessible closeout package, this can transform facilities management, far beyond mere space planning.

Imagine an issue such as a pipe leak occurring. With a BIM model containing all the detailed information regarding the interconnected systems and their associated parts, manuals, and other relevant documentation, a facility manager can easily locate the source of the problem and requirements to fix it.

And a problem that may have taken days and a significant amount of resources to address now takes hours or even minutes.

In general terms, benefits of BIM for asset management are significant because:

- Owners and operators can rely on actionable next steps with closeout packages that are accessible on one platform.
- With better insight into operations, facility managers can work in anticipation of an issue rather than in reaction to a problem.

Operations can be streamlined for years beyond the initial project phase, saving time and money.

BIM processes provide better building products at lower costs to the owner. In view of this, BIM technology will certainly become the standard representation and practice for construction within most of our lifetimes.

BIM Experience at EC

At EC, up to the present, a diversity of projects in different areas of the construction industry (i.e.: commercial, industrial, tall buildings, hospitals, etc.) have been designed by using 3D modeling techniques in the civil, structural, mechanical and electrical disciplines.

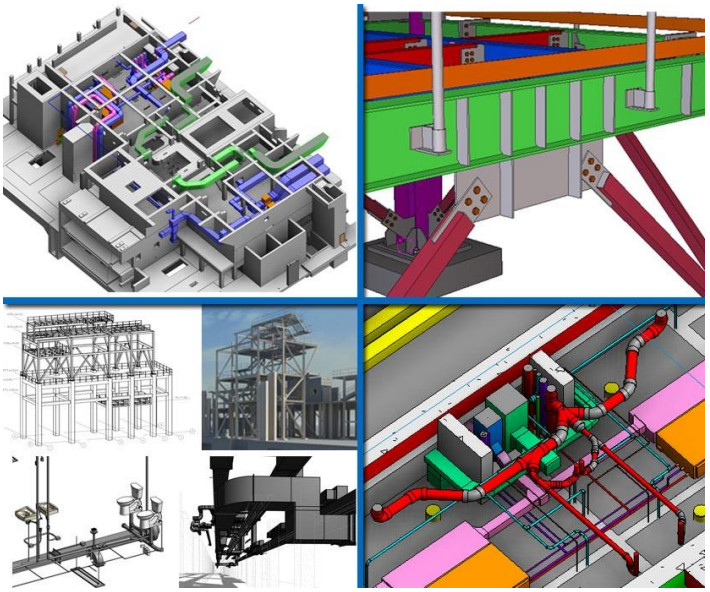

Fig 4: Examples of EC experience in different application areas, gathered with 3D design tools over the past years.

DISCIPLINE	DESIGN SCOPE OF SUPPLY
Structural	Concrete and steel structures
Civil	Potable water supply, sanitary, sewage, eye wash stations, drainage systems in general.
Geotechnical	Geotechnical design, foundations design, piling
Electrical	Internal and external illumination, general purpose outlets (GPO), primary earthing grid, lightning protection
Mechanical	Heat, Ventilation and Air Conditioning (HVAC), Fire Protection System (FPS), piping

Table 2: Overview of the design scope from EC, in the structural, civil, geotechnical, electrical and mechanical engineering disciplines.