

# BIM in Practice

*BIM! What is it?*

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Australian  
Institute of  
Architects

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## INTRODUCTION

This document seeks to provide a common understanding of what is Building Information Modelling (BIM). It provides a definition from the globally acting buildingSMART organisation as well as a number of definitions from other (Australian and international) sources. The second part of this document outlines a 'BIM Glossary of Terms', containing the most fundamental terminology associated with the use of BIM in practice.

## BACKGROUND

The construction industry has long been recognised as inefficient relative to manufacturing and other industries. Highly fragmented, slow to adopt technology, and with poor levels of profitability, the need to change was well recognised in pivotal reports, including the 1998 Egan Report, *Rethinking Construction*, and the 2010 *Productivity In The Buildings Network: Assessing The Impacts Of Building Information Models* by the Allen Consulting Group in Australia. Similar research in other regions identified poor communication, fragmentation, and poor predictability of outcomes in terms of time, cost and quality as major challenges.

In 2006, the American Institute of Architects created a vision to enable the integration of the design disciplines and constructors to form a procurement model known as Integrated Practice. Integrated Practice is enabled by the use of BIM providing integrated technology rich processes through the design, construction and operation of buildings.

The American Institute of Architects Vision - *Imagine a world where all communications throughout the process are clear, concise, open, transparent, and trusting; where designers have full understanding of the ramifications of their decisions at the time the decisions are made; where facilities managers, end users, contractors and suppliers are all involved at the start of the design process; where processes are outcome driven and decisions are not made solely on first cost basis; where risk and reward are value-based, appropriately balanced among all team members over the life of a project; and where the profession delivers higher quality design that is sustainable and responsive. This is the future perfect vision of Integrated Practice.*

## BUILDINGSMART BIM DEFINITION

The abbreviation 'BIM' can be used in several ways. The following are examples of BIM definitions though this document refers to BIM as defined by buildingSMART as follows:

*"A BIM is a digital representation of physical and functional characteristics of a building. As such it serves as a shared knowledge resource for information about a building forming a reliable basis for decisions during its life-cycle from inception onward." - BuildingSMART*

## OTHER INDUSTRY DEFINITIONS:

Authors of Australia's 'National Guidelines for Digital Modelling' describe some characteristics of BIM in the following way:

*A model needs only two essential characteristics to be described as a BIM model. The first is that it must be a three-dimensional representation of a building (or other facility) based on objects, and second, it must include some information in the model or the properties about the objects beyond the graphical representation.*

Source: *National Guidelines for Digital Modelling*, CRC Construction Innovation, [http://www.construction-innovation.info/images/pdfs/BIM\\_Guidelines\\_Book\\_191109\\_lores.pdf](http://www.construction-innovation.info/images/pdfs/BIM_Guidelines_Book_191109_lores.pdf) last accessed on 14.08.2012

### VA - Veterans Affairs (USA)

#### *Building Information Model - Product*

*An object-based digital representation of the physical and functional characteristics of a facility. The Building Information Model serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onward.*

#### *Building Information Modeling - Process*

*A collection of defined model uses, workflows, and modeling methods used to achieve specific, repeatable, and reliable information results from the model. Modeling methods affect the quality of the information generated from the model. When and why a model is used and shared impacts the effective and efficient use of BIM for desired project outcomes and decision support.*

#### *Building Information Management - Data Definition*

*Building Information Management supports the data standards and data requirements for BIM use. Data continuity allows for the reliable exchange of information in a context where both sender and receiver understand the information.*

Source: The VA BIM Guide, USA Department of Veterans Affairs, <http://www.cfm.va.gov/ti/bim/BIMGuide/terms.htm> last accessed on 14.08.2012

### NBIMS - National Building Information Model Standard Project (USA)

*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.*

*A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder*

Source: <http://buildinginformationmanagement.wordpress.com/2010/12/30/what-is-bim-software-business-process/> last accessed on 14.08.2012

## GLOSSARY OF TERMS

### 2D

An overarching term for 2D CAD, 2D drawings (hand or software generated), or the process of producing 2D drawings.

### 3D

An overarching term for 3D CAD, or a 3D model, or the process of producing a 3D model.

### 3D clash detection (or simply: clash detection)

The process of identifying collisions between, or interpenetrations of Model Elements. This can also include identifying Model Elements that lie within a predefined proximity to others.

### 4D BIM or 4D construction sequencing

A 3D model linked to time or scheduling data. Model objects and elements with this data attached can be used for construction scheduling analysis and management. It can also be used to create animations of project construction processes. Source: NATSPEC National BIM Guide, 2011.

### 5D

The process of dividing the project into logical locations and sequence; and linking external data relating to resource (equipment and labour) and material rates to the objects within the aggregate models, for the purposes of cost and 4D planning.

### 6D, 7D... nD

There is currently no consensus on the meaning of these terms. Some say 6D is for Facilities management, some sustainability assessments.

### Aggregate Models

Individual design discipline or trade sub-contractor models.

### Asset Management

A process that can aid in the scheduled maintenance and operation of a facility and its assets.

### Best of Breed

An overarching term for the supply chains' preferred BIM enabled aggregate model authoring software or virtual construction (VC) review and coordination software.

### Best for Project

In relational contracts, decisions are made 'best for project' and not 'best for individual', since the team either wins or loses as a group.

### Building Information Model (BIM) (Product)

*An object-based digital representation of the physical and functional characteristics of a facility. The Building Information Model serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onward.* Source: National Institute of Building Sciences (NIBS) National BIM Standards, 2007.

### Building Information Modelling (BIM) (Process)

*A collection of defined model uses, workflows, and modelling methods used to achieve specific, repeatable, and reliable information results from the model. Modelling methods affect the quality of the information generated from the model. When and why a model is used and shared impacts the effective and efficient use of BIM for desired project outcomes and decision support.* Source: NATSPEC National BIM Guide, 2011.

### BIM Addendum

A contractual arrangement to modify the terms of a standard form agreement to which it is attached to addresses BIM-related issues that were beyond the original scope of the standard form agreement. Two forms exist : AIA E202 – 2008, and ConsensusDOCS C301.

### BEP (Or PXP)

BIM (Project) Execution Plan. A document that succinctly describes the processes and interactions required to achieve the BIM Goals (Also known as BIM Management Plan and Project BIM Plan).

### BIM Goals

Project specific outcomes arising through from the use of BIM processes.

### BIM Manager

An individual responsible for the administration and management of processes associated with Building Information Modelling on a project. The appointment process may vary but the BIM Manager is still effectively an agent of the project owner. While the scope of management may vary, to include activities such as organising, planning, scheduling, directing, controlling, monitoring and evaluating BIM processes, the objective is to ensure that those processes are aligned with the project objectives.

### BIM Relationship Charter

A mantra and reminder that the execution of the chosen BIM Goals are to work for the project.

### CAD

Computer Assisted Design, Computer Aided Drafting, Computer Aided Design

A descriptive term for the use of CAD software for preparation of 2D and 3D CAD.

### 2D CAD

The use of CAD software to prepare 2D lines suitable for presentation on hard copy plots of drawings and/or as background data to other 2D lines.

### 3D CAD

The use of CAD software to prepare 3D lines, surfaces or solids which are suitable for presentation on hard copy plots of drawings, and/or as background data for other 3D data or BIM post processes.

## Capability

The ability to perform a task or deliver a service or product. In this context it is generally taken to mean capability with regard to BIM.

## Cloud Computing

A type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications. In cloud computing, the word "cloud" (also phrased as "the cloud") is used as a metaphor for "the Internet," so the phrase cloud computing is used to mean a type of Internet-based computing, where different services - such as servers, storage and applications - are delivered to an organisation's computers and devices through the Internet.

Source: Webopedia, [http://www.webopedia.com/TERM/C/cloud\\_computing.html](http://www.webopedia.com/TERM/C/cloud_computing.html) last accessed on 14.08.2012

## Cloud-based Services

Services based on cloud computing.

## Code Validation

A process in which code validation software is utilised to check the compliance of model parameters against design codes.

## Construction Operations Building Information Exchange (COBie)

A system for capturing information during the design and construction of projects that can be used for Facility Management purposes including operation and maintenance. A key element of the system is a preformatted Excel spreadsheet used for recording this information. COBie eliminates the current process of transferring massive amounts of paper documents to facility operators after construction has been completed. COBie eliminates the need for as-built data capture after building handover and helps to reduce operational costs. Source: NATSPEC National BIM Guide, 2011.

## Deliverables

The product of engineering and design efforts to be delivered to the client as digital files and/or printed documents. Typically, this would be the concept submittal and the corrected final design. A deliverable may have multiple phases. Source: NATSPEC National BIM Guide, 2011.

## Design and Construct (D&C)

The project procurement method in which the client enters into one contract for the design and construction of a building or project with an organisation, generally based on a building company which provides all project management, design, construction and project delivery services. Source: NATSPEC National BIM Guide, 2011.

## Design-Bid-Build (DBB)

The project procurement method in which the client enters into separate contracts for the design and construction of a building or project. Design and documentation services are generally provided by a professional design consultancy, the documents are used for bidding (tendering) purposes and the successful bidder, generally a building company, enters into a contract with the client to build the project. Often referred to as the 'traditional' method of procurement. Source: NATSPEC National BIM Guide, 2011.

## Discipline Models

Individual design discipline or trade sub-contractor models - aggregate models.

## Federated model

A model consisting of linked but distinct component Models, drawings derived from the Models, texts, and other data sources that do not lose their identity or integrity by being so linked, so that a change to one component Model in a Federated Model does not create a change in another component Model in that federated Model. Source: ConsensusDocs 301 BIM Addendum, 2008.

## FM

Facilities Management

## Federated IFC Model

One or more aggregate models brought together in non-authoring software Industry Foundation Class (IFC) reading for the purposes of virtual construction and data manipulation.

## Federated Open Standard Model

Refer Federated IFC Model

## Federated VC Review Model

One or more aggregate models brought together in non-authoring software for the purposes of virtual construction review.

## File Transfer Protocol (FTP)

The protocol for exchanging files over the Internet. FTP is most commonly used to download a file from a server using the Internet or to upload a file to a server (e.g., uploading a Web page file to a server). Source: Webopedia

## GIS

Geographical Information System.

The computer hardware and software system used to store and analyse graphically referenced (spatial) data and its associated non-graphical attribute data that is stored in a relational database.

## Industry Foundation Class

IFC specification is a neutral data format to describe, exchange and share information typically used within the building and facility management industry sector. IFC is the international standard for openBIM and registered with the International Standardization Organization ISO as ISO16739.

[http://www.ifcwiki.org/index.php/Main\\_Page](http://www.ifcwiki.org/index.php/Main_Page)

## Integrated Project Delivery (IPD) 1

*The project procurement method in which the client enters into a contract with a number of organisations including design consultants and building contractors at the earliest stages of the project to create an integrated team. It is characterised by an expectation that the team will work collaboratively to deliver a product that meets the client's requirements.* Source: NATSPEC National BIM Guide, 2011.

## Integrated Project Delivery (IPD) 2

*A project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction. Integrated Project Delivery principles can be applied to a variety of contractual arrangements and Integrated Project Delivery teams will usually include members well beyond the basic triad of owner, designer and contractor. At a minimum, though, an integrated project includes tight collaboration between the owner, architect/engineers, and builders ultimately responsible for construction of the project, from early design through project handover.* Source: American Institute of Architects - California Council, *Integrated Project Delivery – A Working Definition*, 2007.

## JIT Just In Time

An approach to design and manufacturing processes, focusing on how milestones and material should be executed in order to arrive 'just in time'.

## Lean construction

*A way to design production systems to minimise waste of materials, time, and effort in order to generate the maximum possible amount of value.* Source: Koskela et al., *The Foundations of Lean Construction.* *Design and Construction: Building in Value*, R. Best, and G. de Valence, eds., Butterworth-Heinemann, Elsevier, Oxford, UK 2002.

## Level of Development (LOD)

The American Institute of Architects Document E202 – 2008 *Building Information Modeling protocol Exhibit* defines Level of Development as follows: *“The level(s) of Development (LoD) describes the level of completeness to which a Model Element is developed”*. It describes the steps through which a BIM element can logically progress from the lowest level of conceptual approximation to the highest level of representational precision. The document defines 5 LoDs as described below. Each subsequent level builds on the previous level and includes all the characteristics of the previous levels.

The levels defined (with associated content requirements) are:

- **LoD 100 Conceptual:** Overall building massing indicative of area, height, volume, location and orientation may be modelled in three dimensions or represented by other data.
- **LoD 200 Approximate geometry:** Model Elements are modelled as generalised systems or assemblies with approximate quantities, size, shape, location and orientation. Non-geometric information may also be attached to model Elements.
- **LoD 300 Precise geometry:** Model Elements are modelled as specific assemblies accurate in terms of quantity, size, shape, location and orientation. Non-geometric information may also be attached to model Elements.
- **LoD 400 Fabrication:** Model Elements are modelled as specific assemblies accurate in terms of quantity, size, shape, location and orientation with complete fabrication, assembly and detailing information. Non-geometric information may also be attached to model Elements.
- **LoD 500 As-built:** Model Elements are modelled as constructed assemblies actual and accurate in terms of quantity, size, shape, location and orientation. Non-geometric information may also be attached to model Elements.

Level of Development, by definition, applies to individual Model Elements. When used to describe the BIM model as a whole it is generally taken that all individual Model Elements are of at least that LoD. In practice, strict consistency may not be necessary. A collaboration matrix or Model Progression Specification, as described in *Document E202*, provides a means of specifying the various LoDs required for Model Elements at each phase of the project. Source: American Institute of Architects, *Document E202 – 2008, Building Information Modelling protocol Exhibit*, 2008.

## Maturity

*The quality, repeatability and degrees of excellence of providing BIM services.* It is the sustained ability to excel in performing a BIM-related task or delivering a BIM service or product. Source: Succar, B. *The BIM Maturity Index*, 2009 <http://www.bimthinkspace.com/2009/12/index.html> last accessed on 14.08.2012

## Model

*A three-dimensional representation in electronic format of building elements representing solid objects with true-to-scale spatial relationships and dimensions. A Model may include additional information or data.* Source: ConsensusDocs, *301 BIM Addendum*, 2008

## Model-based Deliverables

Model-based Deliverables (also known as Model Uses or BIM Uses) are the deliverables expected from generating, collaborating on and linking object-based models to external databases. Model-based deliverables include those specific to the Design Phase (e.g. Immersive Environments), Construction Phase (e.g. Construction Logistics and Flow) and Operation Phase (e.g. Asset Tracking)



## Modelling

The process of creating a model or using a model to predict the behaviour of the thing represented by the model.

## Model Collaboration Matrix

See Model Progression Specification. The difference in title simply reflects an emphasis on the collaborative nature of managing the modelling process.

## Model Element

*A portion of the Building Information Model, representing a component, system or assembly within the building or building site.* Source: American Institute of Architects, Document E202 – 2008, *Building Information Modelling protocol Exhibit*, 2008.

## Model Progression Specification

A document, usually a drawn matrix, which summarises how the significant Model Elements that comprise a model are to be progressively developed by reference to the Level of Development required for each element at different phases of the project. It also shows who is responsible for this development (the Model Element Author) at each phase. For project team members, whose ability to fulfil their roles is interdependent, it provides a framework for coordinating their activities.

## Naming conventions

A convention for naming things based on a standardised approach to semantics, syntax and formatting.

## O&M - Operations and Maintenance

The process of linking external data relating specifications and manufacturers' data of as-installed equipment to the objects within the aggregate models, for the purposes of asset maintenance and planning.

## Open Standard Specification

An open standard specification describing the data needed to support operational management, building and system alterations or additions, and asset maintenance scheduling.

## Operational Management

A process in which the data outlined in the open standard specification is used to allocate, manage, and monitor assigned workspaces and related resources.

## Parameter

A numerical or other measurable factor forming one of a set that defines a system or sets the conditions of its operation. In this context it is applied to Model Elements or objects and has effectively the same meaning as the broader term Property.

## Project Manager

*An individual or organisation contracted to administer and manage a project on behalf of the owner. While the scope of project management may vary, to include activities such as organising, planning, scheduling, directing, controlling, monitoring and evaluating, the objective is to ensure that the objectives of the project, manufactured product, or service, are achieved.* Source: Standards Australia, *SAA HB 50*, 2004.

## Project procurement strategy

*Method of project delivery detailing the participant's methods and outcomes necessary to complete the project.* Source: Australasian Procurement and Construction Council (APCC) *A Guide to Project Initiation*, 2010.

## Project server:

A computer or device on a network that manages network resources for a project. There are many different types of servers but in this context it usually refers to one or both of the following:

- *File server: a computer and storage device dedicated to storing files. Any user on the network can store files on the server.*
- *Database server: a computer system that processes database queries.*

Source: Wikipedia, <http://www.webopedia.com/TERM/S/server.html> last accessed on 14.08.2012

## Property

A quality, trait or characteristic belonging to a thing. See Parameter

## QTO - Quantity Take Off

The process of creating a bill or schedule of quantities from data held by objects within the aggregate models.

## SCI- Supply Chain Interaction

A process that engages with the supply chain to explore and understand the potential for data transfer, best of breed software, just in time delivery, optimisation of materials, material preordering and NC data specification.

## Teaming Agreement

A document that sets out the basis on which individually contracted parties will work together for the purposes of meeting their joint obligations.

## VC - Virtual Construction

The interrogation of federated models to test geometrical and spatial fit in a rehearsal of the physical construction process.

## View

A representation of model from a defined vantage point. This can be outside or inside the model, or when seen from one side of a cutting plane intersecting the model.