bim101 - an insight

SEPTEMBER 2016

NZ
bim
industry training group

Preface

On behalf of the NZIOB, the BAC and fellow members of the **BIM Industry Training Group**, We would like to thank you for your recent attendance at BIM 101: An insight seminar.

The BIM Industry Training Group was made up of volunteers who created and presented the seminar series and have now developed this booklet, with information from the seminars, for your future reference. The booklet follows the same format as the seminar.

Apart from disseminating our joint learnings on BIM use in New Zealand, the main aim of our group was to highlight the need to change, explain how BIM and collaboration can help effect that change and start removing perceived barriers to BIM adoption. We therefore recommend that you share this document with your fellow construction industry colleagues so that those who did not attend the seminar may also be inspired.

Thanks go to our respective industry Institutes and the sponsors shown below, without whom these free-to-attend seminars would not have been possible.

Craig, David, Dennis, Glenn, Keeley & Peter
BIM Industry Training Group

Contents

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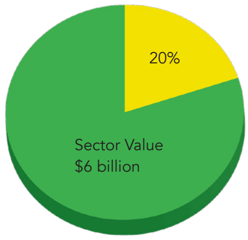
Loss of productivity

The **National Construction Pipeline Report** published in July 2016 put the total value of all construction at around $32 billion, with the non-residential construction component approximately $6–7 billion. Estimates of the cost of poor productivity in our sector range as high as 20%, costing the New Zealand economy up to $1.2 billion annually. If we look to the leading causes, most can be traced back to poor information management.



Poor information flow

CAUSES OF POOR INFORMATION

- Ownership: As multiple disciplines, companies and people become involved with a project, delivery requirements and responsibility can become confused. Duplicate or no information is produced.
- Fee constraints and time pressures: These lead to corners being cut, and appropriate planning and checking is not carried out.
- Contractual arrangements: Poor contractual arrangements, particularly of lowest price wins, mean that the delivery team has failed to understand the extents of the work that has been designed.
- Procurement: This is often traditional design/bid/build, which creates a siloed mentality and adversarial behaviours, with each project stakeholder looking out for their own interests rather than the interests of the wider project team and the client.
- Lack of education and training: Since the 1990s, there is a feeling that the industry has cut back on training – apprentice schemes for those involved in the built environment and overall training for new technologies. Staff generally have not received formal training in the software they use every day.
- Poor use of technology: This leads to a low uptake, misuse and distrust of technology, enhancing views that at least the old system works.

EFFECTS OF POOR INFORMATION

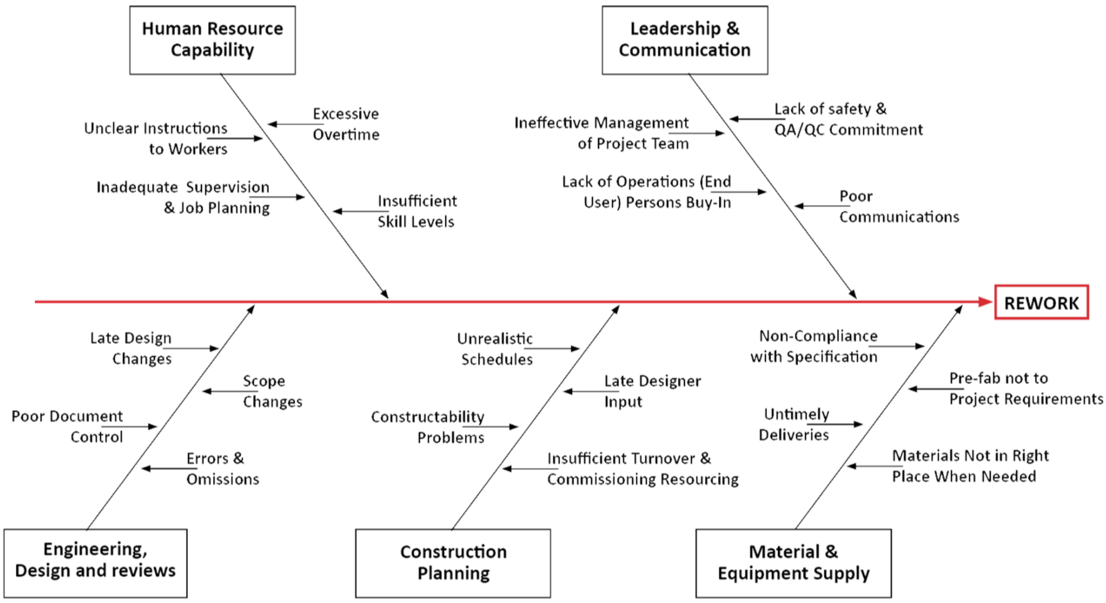
- Requests for information: If the information was complete, you wouldn't need to request additional information.
- Variations: These come from client changes (an incomplete brief) or if the information at the time was inaccurate or ambiguous, which led to errors.
- Contract disputes: An ambiguous contract or incorrect information can lead to disputes.
- Rework: Having to rectify errors.

Disputes and rework can then lead to cost overruns and programme delays, which ultimately can lead to an extension of time.

We make this poor information flow possible and exaggerate its effects by:

- Delaying involvement of contractors, cost consultants, engineers and so on for as long as possible because we think it saves money
- Selection by price with short-term upfront capital costs in mind instead of selection by value
- Having an adversarial approach instead of an aligned commercial arrangement
- Non-standard processes and tools in silos instead of common processes and tools
- Minimal visual drawing checks instead of measurement and comparing the data
- Reinventing the wheel every time instead of developing long-term relationships.

CAUSES OF REWORK

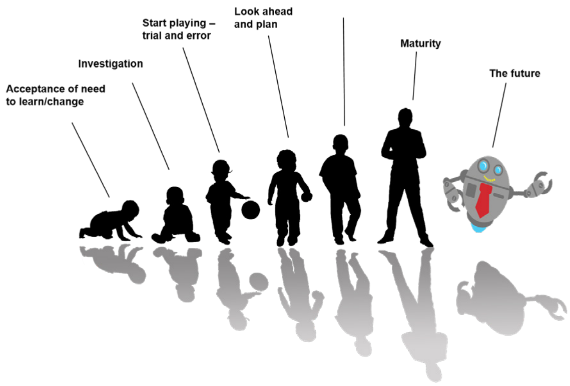


Causes for reworking in Construction (Fayek et al.2004)

How do we change?

It's about changing industry behaviour:

- Removing barriers
- Collaborating more
- Collaborating earlier
- Cooperating freely with less reliance on due process
- Common language and consistency
- Creating and re-using information



To change, we need to take it in steps.

For change and improvement to happen, we are reliant on:

- People – creating reliable information to assist others
- Process – integrating shared information seamlessly
- Technology – connecting people and the process

So that we can achieve:

- Demonstrable better value in our business
- More integrated processes
- Interoperable technology
- More collaborative/cooperative people.

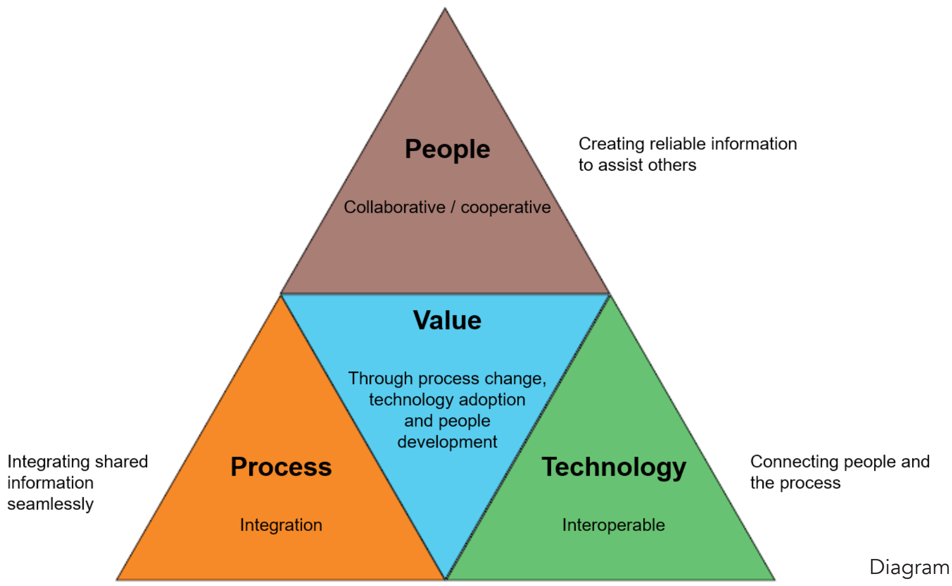


Diagram AECOM

The answer is BIM

"BIM is a digital representation of the 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."

BIM leads to a change in behaviours and promotes a collaborative way of working that achieves clear benefits, underpinned by the technology that unlocks more efficient methods of designing, creating and maintaining built assets.

BIM is a major step change that will:
- Take the complexity out of our build
- Increase the speed of our build
- Enable us to build better for less.

The future is about adapting and adopting new processes, methods and skills, embracing new technology, active discussion on the future of industry, striving to and meeting goals to reduce rework and significantly improving the production and delivery of information to fellow stakeholders.

BIM around the world

When looking at the countries that have been influenced by or are influencing the development of BIM, we focus on those that are attempting to standardise their approach or are applying steps to accelerate BIM adoption. Some groups are driving mandatory BIM implementation programmes (UK, Singapore), while others are trying to accelerate the adoption of BIM.

These countries have national guidelines:

- America
- Australia
- Austria
- Canada
- Finland
- Hong Kong
- New Zealand
- Norway
- Singapore
- UK

These countries have national groups driving BIM:

- UK — BIM Task Group
- Germany — BIM Task Group
- Hungary — Hungarian BIM Council
- Canada — Canadian BIM Council
- Hong Kong — Hong Kong Institute of BIM
- New Zealand — BIM Acceleration Committee
- Singapore — Building Construction Authority

Below, we look at those countries that have made significant contribution to the adoption of BIM around the world and where New Zealand got the inspiration to work with and promote BIM adoption in New Zealand.

USA

AIA BIM Protocol E202 – developed in 2008, revised in 2013.

The BIM Forum Level of Development Specification – developed in 2011, revised in 2015 – set the standard globally for LOD.

Research programme awarded to Penn State University in 2007 to develop a BIM execution planning guide to help ensure all parties are clearly aware of opportunities and responsibilities associated with the incorporation of BIM into a project.

The Penn State University guide is widely accepted as industry standards and acted as a seed for BIM development globally:
- BIM project execution planning guide
- BIM planning guide for facility owners
- BIM uses
- BIM use process maps.

UK

31 May 2011 Government Construction Strategy published with the following goals:
- 5-year programme for sector modernisation (industrial to digital).
- Reduce whole-of-life cost by 33%.
- Reduce the cost of project delivery by 50%.
- Reduce carbon emissions by 20%.
- Increase construction exports by 50%.

BIM is central to this ambition.

By 2016, government will require "collaborative 3D BIM with all project and asset information, documentation and data being electronic" i.e. Level 2 BIM.

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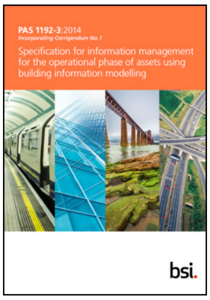
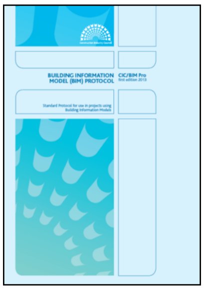
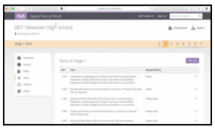
THE 8 PILLARS OF LEVEL 2 BIM








NBS BIM Toolkit

- PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using building information modelling.
- PAS 1192-3 Specification for information management for the operational phase of assets using building information modelling.
- BS 1192-4 Collaborative production of information – Part 4: Fulfilling employer's information requirements using COBie – Code of practice.
- PAS 1192-5 Specification for security-minded building information modelling, digital built environments and smart asset management.
- The CIC BIM Protocol – a contract addendum to address intellectual property, roles and responsibilities, liabilities, etc.
- Government Soft Landings – an approach to aftercare, ensuring that what was designed and built performs as expected.
- Digital Plan of Work – a web-based tool similar to the CIC. Guidelines that support the development of briefing documents and defining deliverables.
- National Classification System – to classify BIM objects to ensure that they can be used by others.

February 2015 – the Strategic Plan for Level 3 BIM was launched. It focuses on smart buildings, smart assets, sensors etc. and shows that BIM isn't something that will go away any time soon.

CASE STUDY – COOKHAM WOOD PRISON

- 20% capex saving on the design and construction.
- Saved the UK Government £840 million in 2013.
- Target for 2014 was £1.2 billion.
- Too early for opex statistics – but the government is investing in the future by paying for data deliverables (Construction Operations Building Information Exchange (COBie) – a data format for the publication of a subset of building model information).
- The statistics above are verified by the independent office of statistics in the UK, they are hard facts and not just marketing hype.

Singapore

May 2012 – Building and Construction Authority (BCA) Singapore published the Singapore BIM Guide:

- Aiming for productivity improvements in delivery (capex).
- Modelling templates for architectural, structural and services.
- e-submission required for all government projects.

DOCUMENT INFRASTRUCTURE

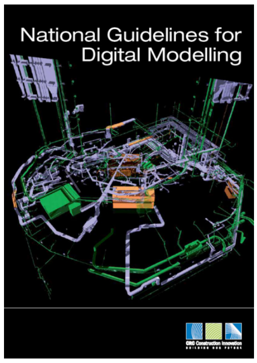
- Singapore BIM Guide – an overview of BIM.
- BIM Essential Guides – these are discipline-specific documents:
- BIM adoption in an organisation
- MEP consultants
- Civil and structural consultants
- Architectural consultants
- Contractors
- BIM execution planning.

TECHNOLOGY ADOPTION – BIM FUND

- To support BIM adoption in the industry, the Singapore BCA set up a BIM fund:
- Aimed at supporting company adoption and project adoption of BIM.
- Funding available for up to the first six projects.

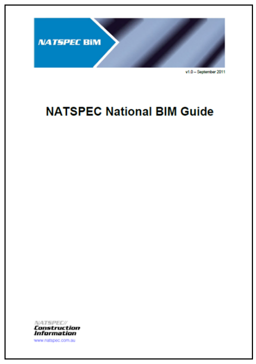
Australia

Australia has had several attempts at accelerating the adoption of BIM in the construction industry.



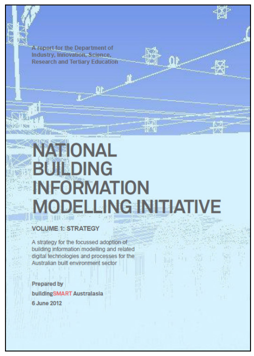
The National Guidelines for Digital Modelling were published in July 2009:

- Collaboration between industry, government and research partners.
- Industry input was quite contractor driven (five contractors) – this is a sign of who was leading BIM initially in Australia.
- Looked at the potential of digital modelling and how modelling can support project collaboration.
- Challenges such as a lack of standard objects, potential file sizes, software interoperability.



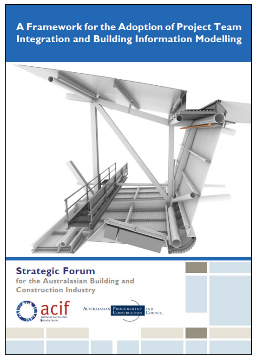
In 2011, NATSPEC (a not-for-profit organisation aiming to improve the industry) developed BIM guidelines for use in Australia, including:

- BIM brief template
- BIM management plan template (which is similar to a BIM execution plan in New Zealand – the NZ BIM Handbook was based on the NATSPEC documents).
- Widely accepted as the Australian 'standard' for BIM Management Planning.



In 2012, the National BIM Initiative report was published:

- Led by Building SMART.
- Co-funded by the government.
- Published in two volumes – a strategy and an implementation plan.
- The report stated that the Australian economy would increase GDP by $7.6 billion over 10 years if its recommendations were adopted.



In December 2014, A Framework for the Adoption of Project Team Integration and Building Information Modelling was published. Supported by central government and developed in conjunction with industry (including New Zealand representation through MBIE), it focuses on:

- People
- Procurement
- Protocols
- Asset management
- National object standards
- Information exchange
- Technology.

In 2016, NATSPEC published revised documents including separate design and construction BIM management plans.

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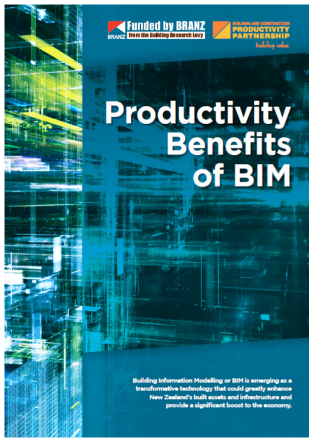
How did we get here?



INCREASE PRODUCTIVITY
20% by **2020**

The Productivity Partnership was formed in 2010 to address low productivity in the construction industry and empower the industry to adopt new tools, technologies and systems.

- The Productivity Partnership, sponsored by MBIE, formed the BIM Acceleration Committee with a mandate to accelerate the uptake of BIM in New Zealand.
- Productivity Benefits of BIM brochure published.
- NZ BIM Handbook launched in July 2014 – funded by the Productivity Partnership and industry-wide donation of time.
- Case studies published Q4 2014.
- BIM survey – measuring New Zealand success (75% of adopters reported improved collaboration, 57% of designers reported reduced design errors and rework, average project duration reduced by 37%, 65% of contractors reported that BIM reduced rework and cost overruns, 62% of adopters reported a positive ROI).
- Industry training, supported by the BIM Acceleration Committee, MBIE and BRANZ.

NZ BIM Handbook

NATSPEC authored the first iteration of this guide to clarify BIM on a national level.

What the NZ BIM Handbook covers:
- BIM basics
- Project BIM brief
- BIM execution plan
- Modelling and documentation practice
- Enabling facilities management via BIM
- Appendices:
- Modelling and documentation practice

- NZCIC phases with BIM uses and tasks
- Levels of development definitions
- BIM uses definitions
- Project BIM brief (example and template)
- Project BIM execution plan (example and template)

Currently under revision to incorporate some UK BIM components and other minor tweaks and due to be rereleased in the last quarter of 2016.

New version will include a section on workflow and an appendix on collaboration.

BIM in action – case studies

- Currently, there are seven published case studies on the Building Information Modelling (BIM) in New Zealand website:
- Ara Institute of Canterbury, Kahukura Block
- Christchurch Justice and Emergency Services Precinct
- Unitec, Integrated Information System
- University of Auckland, Undergraduate Laboratories
- Tauranga Hospital, Kathleen Kilgour Centre
- North Shore Hospital, Elective Surgery Centre
- Wellington City Council, Bracken Road Flats
- These cover a range of uses from 3D modelling and coordination to 5D quantity take-off and asset management and show that BIM can be used on large projects, small projects, new build projects and refurbishments/retrofits.

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BIM adoption in New Zealand

BIM IN NEW ZEALAND – AN INDUSTRY-WIDE VIEW (2014 AND 2015)

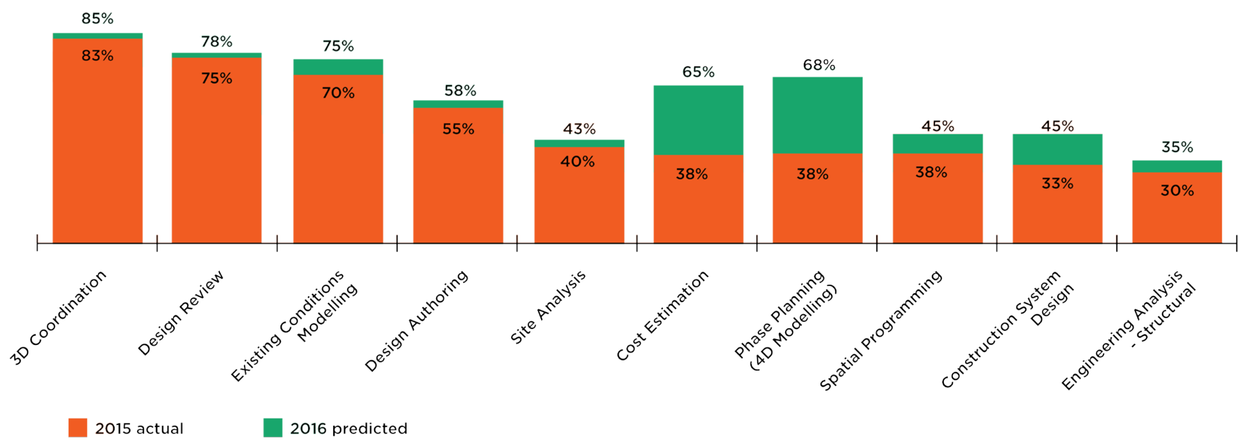
www.eboss.co.nz/bim-in-nz-an-industry-wide-view

This covers a control group of 46 businesses and individuals in Auckland, Bay of Plenty, Wellington, Canterbury and Otago/Southland who have been identified as key users of BIM technology within the building and construction industry.

It provides a benchmark that can be measured each year to understand the depth of BIM adoption in the industry.

The study has identified the top 10 most popular BIM uses. The graph below shows that phase planning (4D) dropped in use between 2014 and 2015, while the other uses all increased.

Control Group Organisations	
22 Degrees	Maltbys
AECOM NZ	Mott MacDonald
Athfield Architects	MSC Consulting Group
Aquaheat Industries	MWH New Zealand
Archaus Architects	Nauhria Precast & Reinforcing
Architectus	Naylor Love Construction
AS Built	Norman Disney & Young
Assemble	NZ Strong Construction
Auckland University of Technology	Opus International Consultants
Barnes Beagley Doherr	Patterson Architects
Beca	Peddle Thorp
BGT Structures	RCP
Davis Langdon	Stephenson & Turner
Dominion Constructors	Structex
Envivo	The Warehouse Group
Fletcher Construction	University of Canterbury
Ganellen	University of Otago
Hawkins Construction	Victoria University of Wellington
Holmes Consulting Group	Warren & Mahoney Architects
Ignite Architects	Wellington City Council
Jasmax	Woods
Jensen Steel	WT Partnership
KTA	Xigo

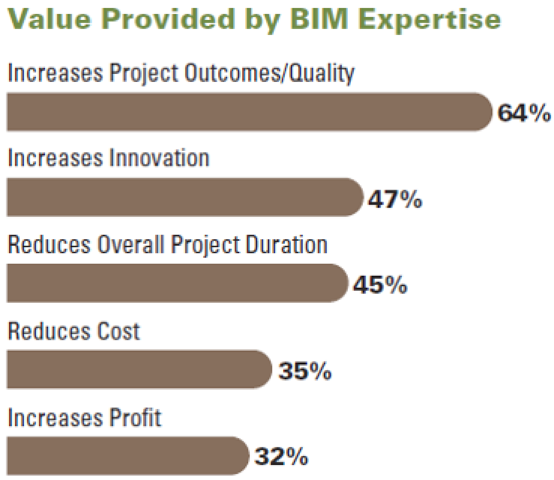


THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND: HOW BUILDING INFORMATION MODELING IS TRANSFORMING THE DESIGN AND CONSTRUCTION INDUSTRY (2014)

McGraw Hill Construction

Source: McGraw Hill Construction, 2013

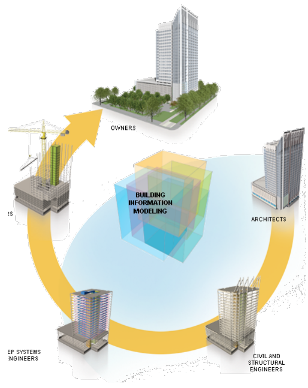
Benefit	Architects/ Engineers	Contractors
Reduced Errors and Omissions	50%	38%
Overall Enhancement of Your Firm's Image as an Industry Leader	36%	43%
Reducing Rework	31%	28%
Ability to Work Collaboratively With Owners or Design Firms	27%	24%
Offering New Services	24%	14%



Note: McGraw Hill information is based upon perceived industry data and not measured data.

What is BIM?

BIM is a workflow or process.



BIM requires high-quality, coordinated, internally consistent information that can be relied on.

BIM extends across the design, construction and operation of an asset.

By adopting BIM, architects, engineers, contractors and owners can:

- Easily create coordinated, digital design information and documentation
- Use that information to accurately predict performance, appearance and cost
- Reliably deliver the project faster, more economically and with reduced environmental impact.

The fundamental definition of BIM should be that there is always a 'single source of the truth'.

The UK-based B1M website is a useful resource (www.theb1m.com). Co-founder Fred Mills has prepared a number of no-nonsense videos to clarify the misconceptions around BIM.

Watch video: Top 3 BIM myths dispelled

Definitions of BIM

There are three recognised definitions of the BIM acronym:

Building information *model*
(The model that is produced)

BIM, the ***model***:
"I am creating a BIM"

Building information *modelling*
(The process used to create the model)

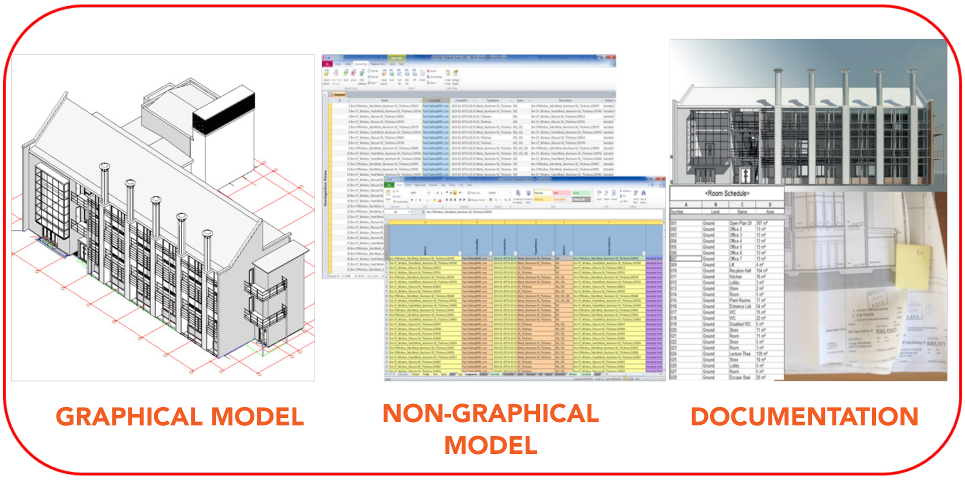
BIM, the ***process***:
"We will deliver this project using BIM"

Building information *management*
(The strategy used to manage the model)

BIM, the ***management***:
"We have prepared a BIM strategy"

BUILDING INFORMATION MODEL

The building information model is not a single 3D object but an assembly of digital information. It is made up of three main parts.



Graphical model

- A graphical model is a 3-dimensional representation of an asset.
- It may start off as a generic conceptual shape that matures during design development..
- This model is generally created in 3D authoring software.

Non-graphical model

- The non-graphical model consists of information such as properties, specifications, room data sheets, schedules and cost data.
- Non-graphical information is generally attached to the objects in the 3D graphical model.
- Non-graphical data can be exported for use by other teams such as the contractor, quantity surveyor and facilities manager.
- Some of this may be created initially within the graphical model and then exported to other formats or it may be non-graphical data purely managed in external databases or other bespoke information systems.
- The non-graphical model uses elements from the 3D authoring software, but it isn't necessarily created entirely via the 3D model.

Documentation

- Documentation consists of floor plans, sections, elevations and details, visualisations and schedules.
- Documentation is produced directly from the graphical and non-graphical models.
- The documentation is printed and issued for project deliverables in the form of paper or electronic paper such as PDF.
- The management of the flow of documentation is crucial to the delivery of a building information model.
- Documentation is generally created wholly or uses elements from the 3D authoring software and includes specifications, schedules and technical drawings.

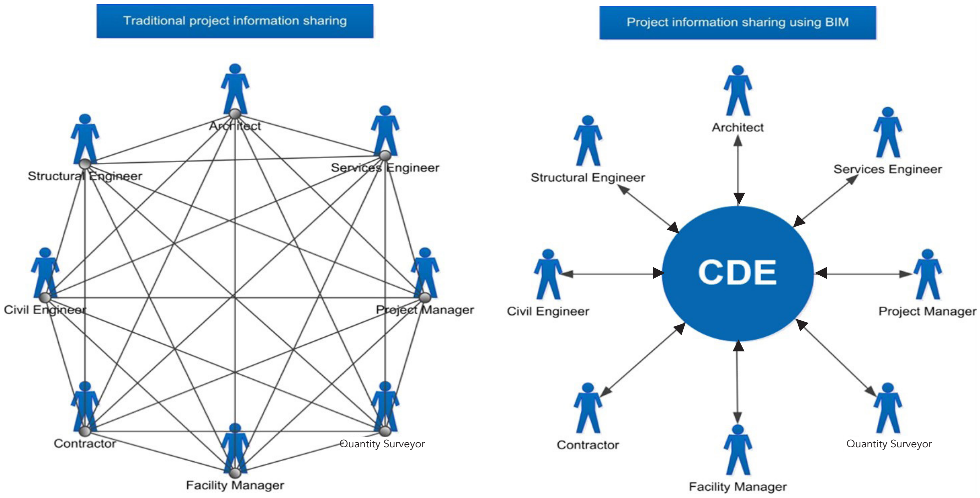
BUILDING INFORMATION MODELLING

Building information modelling as a process requires standards, methods and processes (SMPs) to help to produce a good model and facilitate collaboration and information exchange.
There are a number of SMPs in place across the world, but in New Zealand, the starting point is the NZ BIM Handbook and appendices, which include modelling and process best practices.

BUILDING INFORMATION MANAGEMENT

The traditional information management process is disjointed, resulting in poor information. Building information management requires collaboration between all project stakeholders.

BIM encourages information exchange through a single common data environment (CDE), which allows each member of the design team to access the most up-to-date and appropriate information

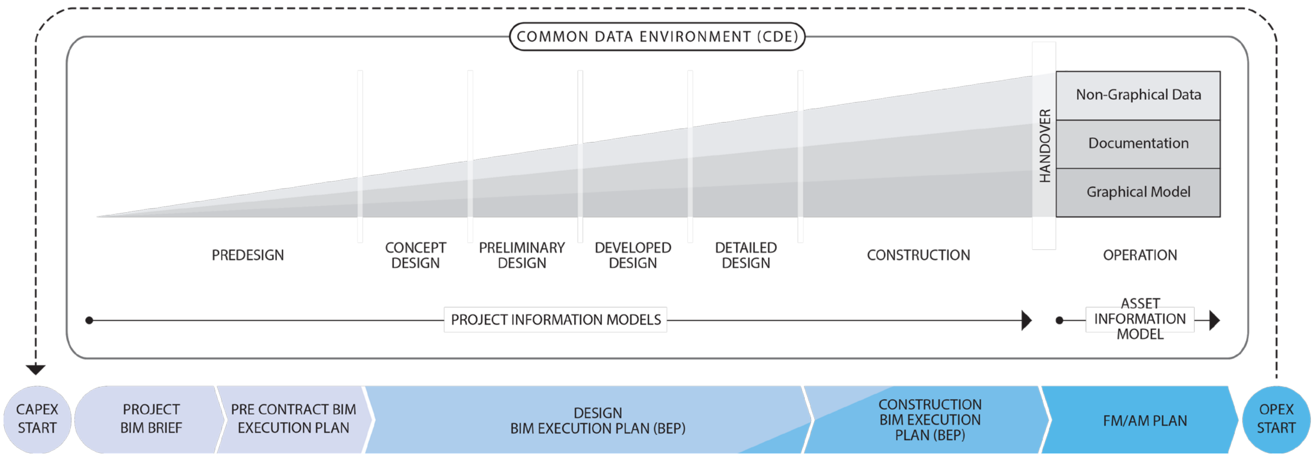


BIM encourages information exchange through a single common data environment (CDE), which allows each member of the design team to access the most up-to-date and appropriate information.

How the CDE is created and managed is one of the requirements of the BIM execution plan (BEP), which provides a solid framework to prepare and document the strategy for implementing a BIM project. The NZ BIM Handbook includes a BEP example and template, which are an excellent starting point.

The diagram below is the BIM information delivery cycle from the NZ BIM Handbook. This diagram explains at a high level the management processes through the life of a BIM project

THE INFORMATION DELIVERY CYCLE



The information delivery cycle has two distinct start points:

- For stand-alone new-build projects, where the focus is on capital delivery efficiencies rather than ongoing operational requirements, start at the bottom left corner (Project BIM Brief).
- For projects that are part of a larger asset portfolio or for projects that involve existing assets, start at the bottom right corner (FM/AM Plan). This will draw on information from the existing asset information model.

The blue flowchart shows the generic process for identifying a project need, defining a project's BIM requirements, procuring a suitable team, executing the design and construction BIM requirements and producing project and asset information models that are relevant to the project need.

For clarity, the project information model is defined as all of the information needed to design and construct an asset. This information can include graphical models, documents (drawings, schedules, etc.) and data. The asset information model is defined as all of the information required to operate an asset, which can include graphical models, documents (drawings, warranties, product manuals, etc.) and data. The grey wedge represents the NZ CIC design stages. Models and associated documentation and data will be developed in accordance with these stages and are to support any project-specific BIM use requirements.

This is bounded by the common data environment, which will be used to collect, manage, disseminate, exchange and retrieve project information throughout the project life cycle. Information is exchanged between project stakeholders at agreed milestones using the CDE as agreed to in the project BIM execution plan.

BIM maturity

BIM maturity is a measure of the ability of the project team to create, manage and exchange information. It is applied to an entire project scenario.

BIM maturity is classified into levels. As each level progresses, the technology, maturity and benefits increase. For example, an organisation may have projects that are operating at a high level of maturity, but it may also have a number of projects that are only able to operate at a low level of maturity.

This diagram below shows the BIM maturity wedge, used to understand BIM maturity. (This is UK terminology, but is widely understood in New Zealand.)

The red ramp indicates that we are on a journey, and the blue vertical line identifies what we are currently aiming for in the New Zealand construction industry.

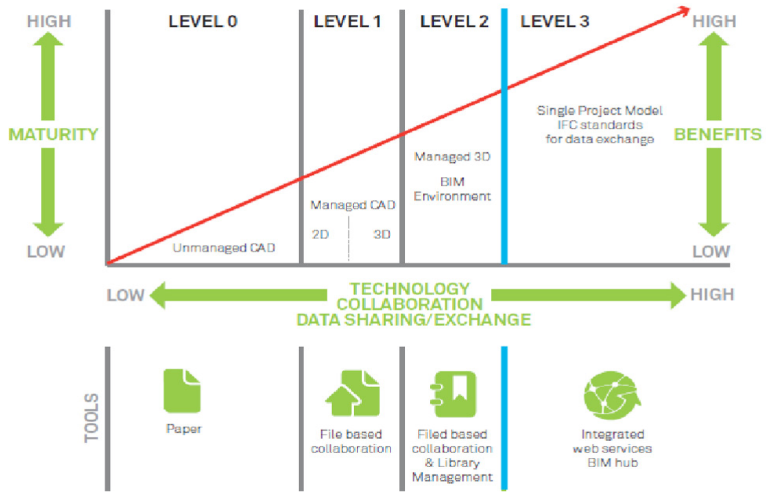


Diagram developed by AECOM.

LEVEL 0 – UNMANAGED CAD

- Basic 2D CAD or drawing board documentation with paper (or PDF) as the most likely data exchange mechanism.

LEVEL 1 – MANAGED CAD IN 2D OR 3D FORMAT

- Level 1 refers to more developed 2D or 3D CAD, using some basic management strategies to control data exchanges and coordination.
- For example, Level 1 BIM might include a common data environment.

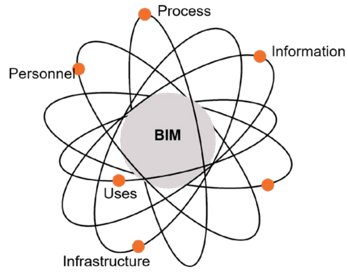
LEVEL 2 – MANAGED BIM IN A 3D ENVIRONMENT

- Level 2 refers to managed BIM, where separate 3D models are created by each discipline, with attached data.
- For example, Level 2 BIM will require a BIM execution plan.
- A high degree of SMPs and management strategies are in place to control all aspects of information creation and exchange.
- Level 2 can be delivered using existing procurement strategies and does not require changes to professional indemnity as it keeps existing ownership and liability clearly defined.

LEVEL 3 – INTEGRATED BIM

- Level 3 refers to integrated BIM where a single model is created in a central collaborative model server, with all stakeholders creating and sharing information in the same space.
- Level 3 is presently unachievable, taking into account existing procurement, software capabilities, industry knowledge and legal and contractual requirements.

BIM standards, methods and processes (SMPs)

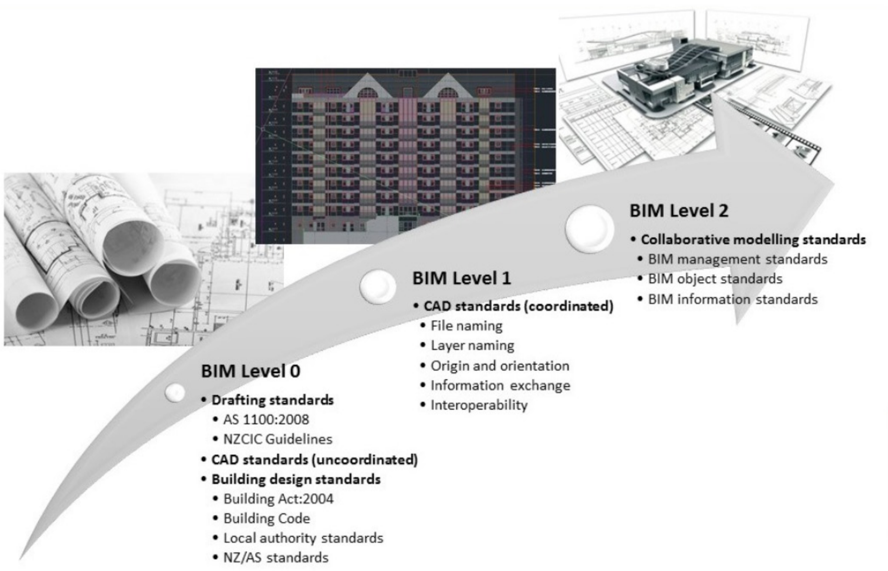


SMPs are fundamental to the successful delivery of a BIM project.

They are the glue that holds the information together, like the atoms around a nucleus.

They are required for all aspects of design, documentation, information and management.

Each BIM maturity level has a set of SMPs.



BIM uses

BIM uses could be viewed as a 'shopping list' for BIM implementation on a project. They should be carefully selected to support project objectives and where a client or client advisor feels that they will add value to a project.

In Appendix D of the NZ BIM Handbook, 21 separate uses have been identified and an outline definition provided, for example:

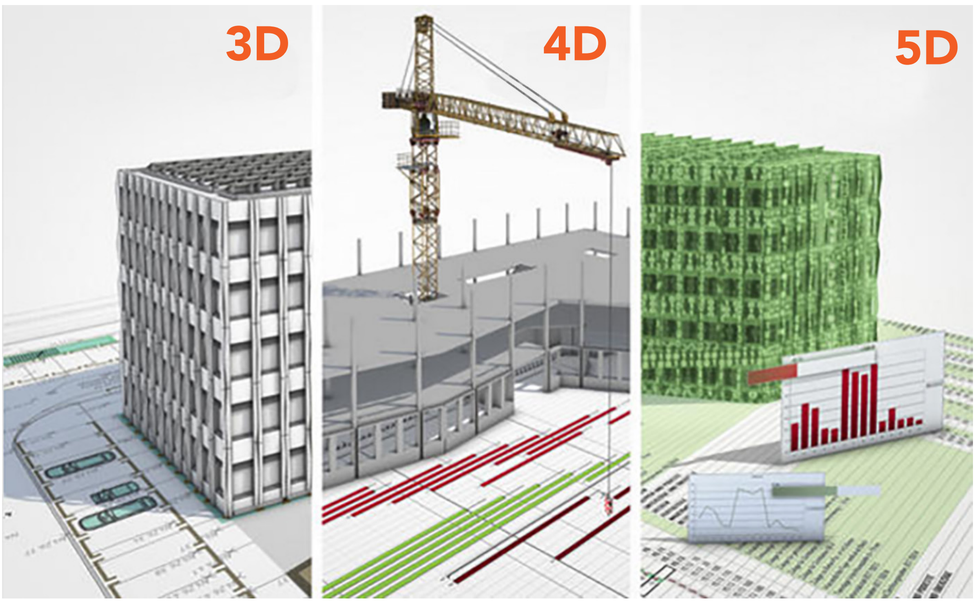
- Design authoring – a process in which software is used to develop a building information model
- 3D coordination – a process used to determine and resolve conflicts of geometry within the BIM that would result in problems during construction.

Some of the uses will be commonly used on projects – others are an indication of where BIM may be applied in the future.

A BIM project could have a high level of maturity though the application of SMPs but utilise few BIM uses.

BIM dimensions

The way that BIM information is created and used on a project can also be given a BIM dimension.



bim 101
an insight

2D

- 2D drawing typically involves using computer-generated lines to represent an object, such as a wall.
- The software doesn't recognise this as a wall – it is just a rectangle filled with patterns that we recognise visually as a wall.
- There is no data attached to the object.

3D

- 3D modelling uses objects instead of lines.
- The software recognises this object as a wall.
- 2D documentation can be generated from the 3D object.
- The object can also contain non-graphical data such as height, width and specification information.

4D

- 4D modelling refers to the addition of time information to a 3D object.
- This typically involves integrating the project programme with the 3D model objects.
- 4D models can be used by contractors to plan and track construction progress.
- The 4D information is usually assigned to 3D objects through specific 4D software.

5D

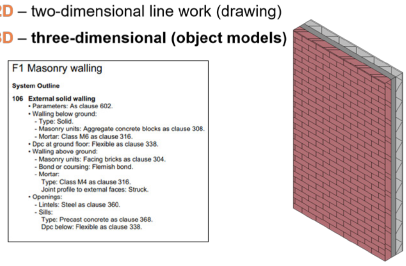
- 5D modelling refers to attaching cost data to a 3D object.
- This typically involves integrating the QS cost scheduling information with the 3D model objects.
- 5D models can be used by quantity surveyors to plan and track construction expenditure.
- The 5D information is usually assigned to 3D objects using specific 5D software.

ND

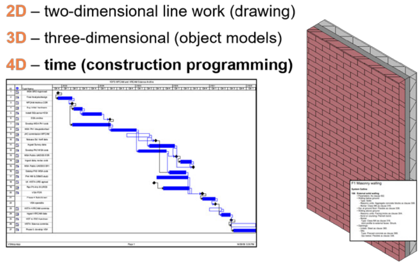
- There are additional BIM dimensions defined in other parts of the world, e.g. 6D, 7D and 8D. The definition of these dimensions differs depending on the information source/country of origin.
- However, the New Zealand construction industry and the NZ BIM Handbook are currently only recognising up to 5D.

- **2D – two-dimensional line work (drawing)**

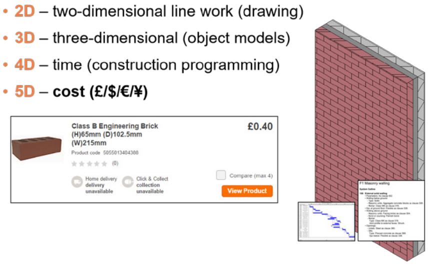
- 2D – two-dimensional line work (drawing)
- **3D – three-dimensional (object models)**



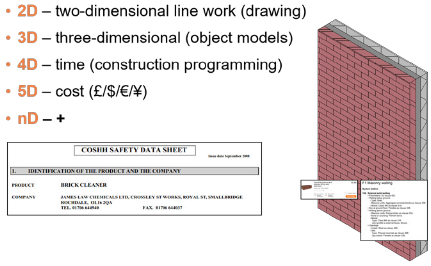
- 2D – two-dimensional line work (drawing)
- 3D – three-dimensional (object models)
- **4D – time (construction programming)**



- 2D – two-dimensional line work (drawing)
- 3D – three-dimensional (object models)
- 4D – time (construction programming)
- **5D – cost (£/$/€/¥)**



- 2D – two-dimensional line work (drawing)
- 3D – three-dimensional (object models)
- 4D – time (construction programming)
- 5D – cost (£/$/€/¥)
- **nD – +**



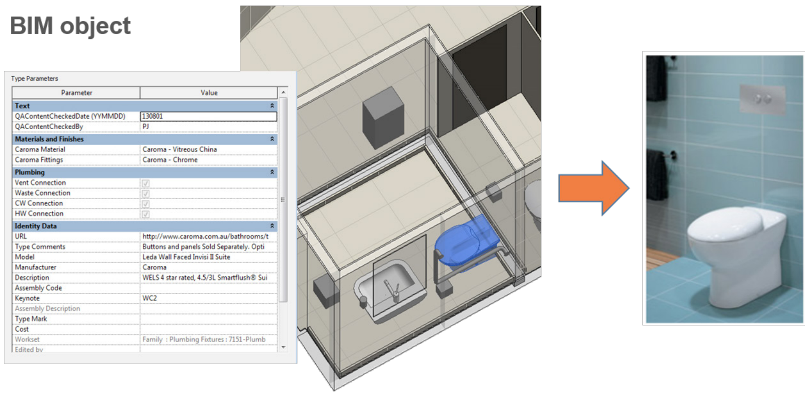
BIM objects

Building information models are created by assembling BIM objects.

A BIM object is a virtual representation of a real object, such as a toilet pan, a wall or a duct. It is a combination of detailed information that defines the product and geometry that represents the product's physical characteristics.

Non-graphical information is usually attached to the BIM object containing data such as size, finish and specification information.

The object can be generic or manufacturer specific (where it will contain manufacturer's data).



BIM object level of development

Every BIM object has a level of development (LOD).

LOD is defined in a range from LOD 100 (basic – low reliance) through to LOD 500 (as constructed – high reliance).

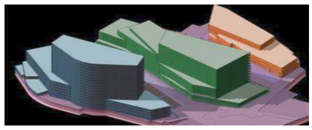
The LOD specifies its content and reliance at various stages of a construction project:

- At concept stage, a BIM object that is placed in a model will be unreliable in terms of its position and data (i.e. very likely to change).
- At fabrication stage, a BIM object that is placed in a model will be very reliable (because the BIM object can be used to fabricate the item).

Project models at any stage of delivery will invariably contain elements and assemblies at various levels of development. As an example, it is not logical to require all BIM objects at LOD 200 at the completion of the schematic design phase. Instead, the model will more likely contain BIM objects at various levels of development, typically both LOD 100 and LOD 200.

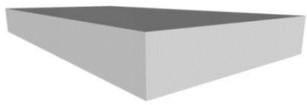
Below is an example of LODs for a concrete double tee floor.

LOD 100 – BASIC



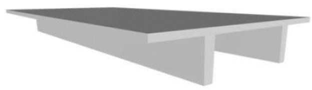
- Used to describe BIM objects that are basic and very likely to change size, position or specification.
- Graphical information can include solid mass model representing overall building volume or schematic elements that are not distinguishable by type or material.
- Non-graphical information is not required.
- Low reliance on content, position and size.

LOD 200 – APPROXIMATE



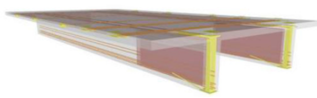
- Used to describe BIM objects that are approximate and likely to change size, position or specification.
- Graphical information to include type of structural concrete system and approximate geometry (e.g. depth) of structural elements.
- Non-graphical information is not required.
- Low/medium reliance on content, position and size.

LOD 300 – ACCURATE



- Used to describe BIM objects that are accurate and not likely to change size, position or specification.
- Graphical information to include accurate size, profile and position of all members and material definition.
- Non-graphical information to include materials, finishes, reinforcing and performance specification.
- High reliance on content, location and size.

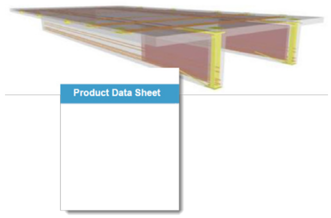
LOD 400 – FABRICATION/CONSTRUCTIBLE



- Used to describe BIM objects that are constructible and will not change size, position or specification.
- Graphical information to include all reinforcement including post-tension elements detailed and modelled; finishes, camber, chamfers, etc.

- Non-graphical information to include materials, finishes, camber, chamfers, reinforcing, live loads etc.
- Very high reliance on content, location and size.

LOD 500 – AS CONSTRUCTED



- Used to describe BIM objects that are verified as constructed and contain the installed item's size, position and specification data.
- Graphical information can include element modelling as LOD 200/300/400.
- Non-graphical information to include information regarding as-installed unit, e.g. warranties, service agreements, manufacturer data sheets etc.
- Absolute reliance on content, position and size.

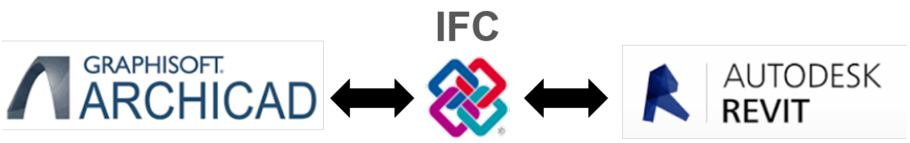
Interoperability

Reliable information exchange is fundamental to a successful BIM project. There is a wide variety of software and technology that is used across the BIM spectrum, so interoperability is key to reliable exchange of data between these different BIM applications. As a scheme progresses, there is a shift between the proportion of graphical and non-graphical data required:

- At design, most of the information required is graphical, using models for spatial design and outline specifications.
- At construction, further non-graphical information is required through detailed specifications.
- At operation, most of the information required is non-graphical to support FM and AM tasks.

INDUSTRY FOUNDATION CLASSES (IFC)

Industry Foundation Classes (IFC) is a file format that makes it possible to exchange 3D model and associated non-graphical information between consultants that use different software.

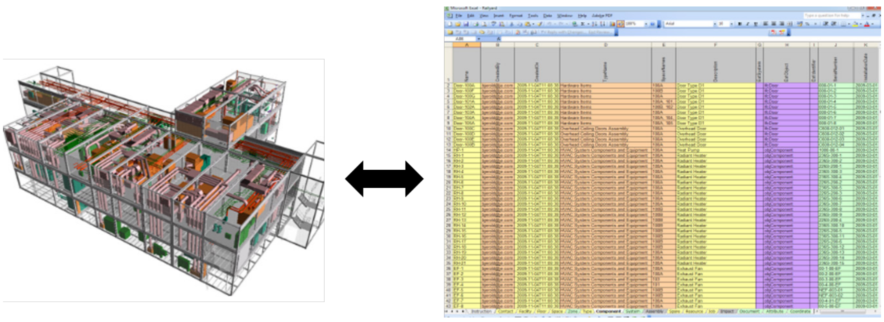


For example, if an architect using ArchiCAD wishes to share model and non-graphical information with a structural engineer using Revit, there is an interoperability problem because Revit cannot open ArchiCAD .pln files. The architect would export the ArchiCAD model to IFC format and then send this IFC file to the engineer who can then import/open the IFC model in Revit and interrogate model and non-graphical information.

There are a number of other software applications developed to utilise IFC, such as model viewers, 4D programming, 5D estimating and clash detection tools. It also allows a model to be federated (combined into a single model) with a number of different native models prior to using these tools so that a complete model can be assessed.

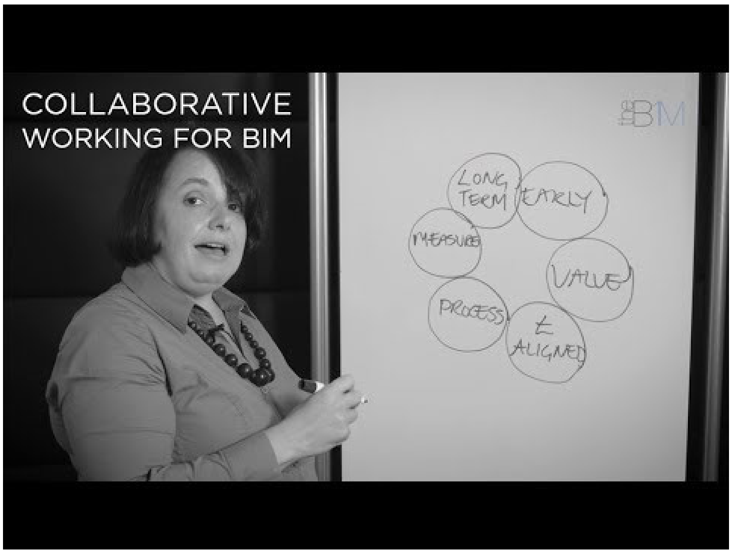
CONSTRUCTION OPERATIONS BUILDING INFORMATION EXCHANGE (COBIE)

Construction Operations Building Information Exchange (COBie) is a spreadsheet file format used to exchange non-graphical information for facilities management applications. It can be viewed in design, construction and maintenance software as well as in simple spreadsheets and can be used in all projects regardless of size and technological sophistication.



Information within COBie can be imported directly from the information model. This means that there is a degree of confidence that the information contained within is correct. As an industry standard, it provides a platform for computer-aided facility management (CAFM) tools to import this information into their respective systems.

There needs to be a high level of collaboration to ensure the BIM execution plan is adhered to.



Some words of wisdom from social strategist Su Butcher from the B1M website (www.theb1m.com).

Watch video: Collaborative working for BIM

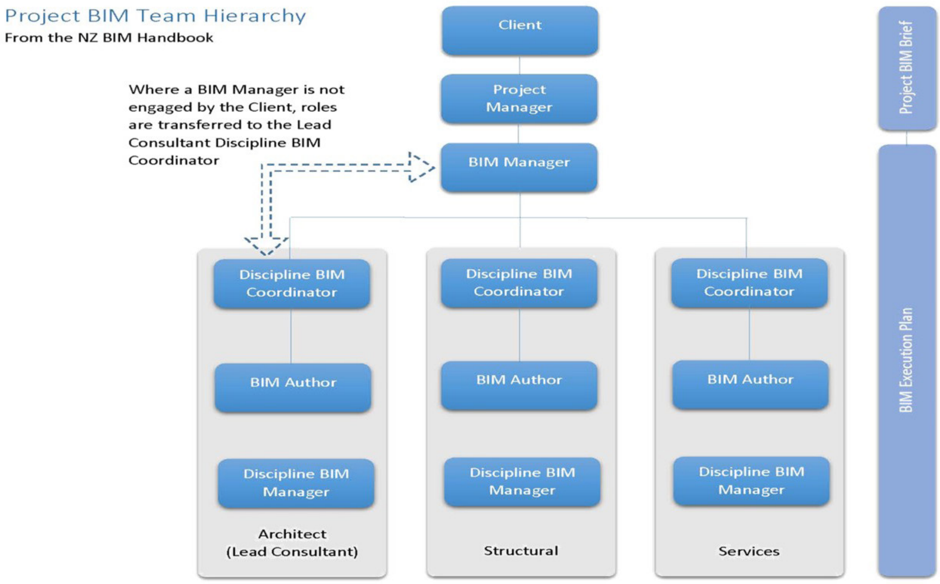
Relationships

This collaboration occurs with relationships through the industry and trust and alignment of expectations.

BIM MANAGER

The person engaged by the client (either independently or as an extension to another consultant's role). They lead the production of the project BIM brief and project BIM execution plan and coordinate the input of the other project participants. Their focus includes combining/federating the various models into a single, coordinated model that contains consistent and structured information to support project deliverables.

The BIM manager may be engaged for the entire project or separately for the design and construction phases. The BIM manager may also be the lead consultant or the project manager if the client chooses not to engage the role separately.



DISCIPLINE BIM COORDINATOR

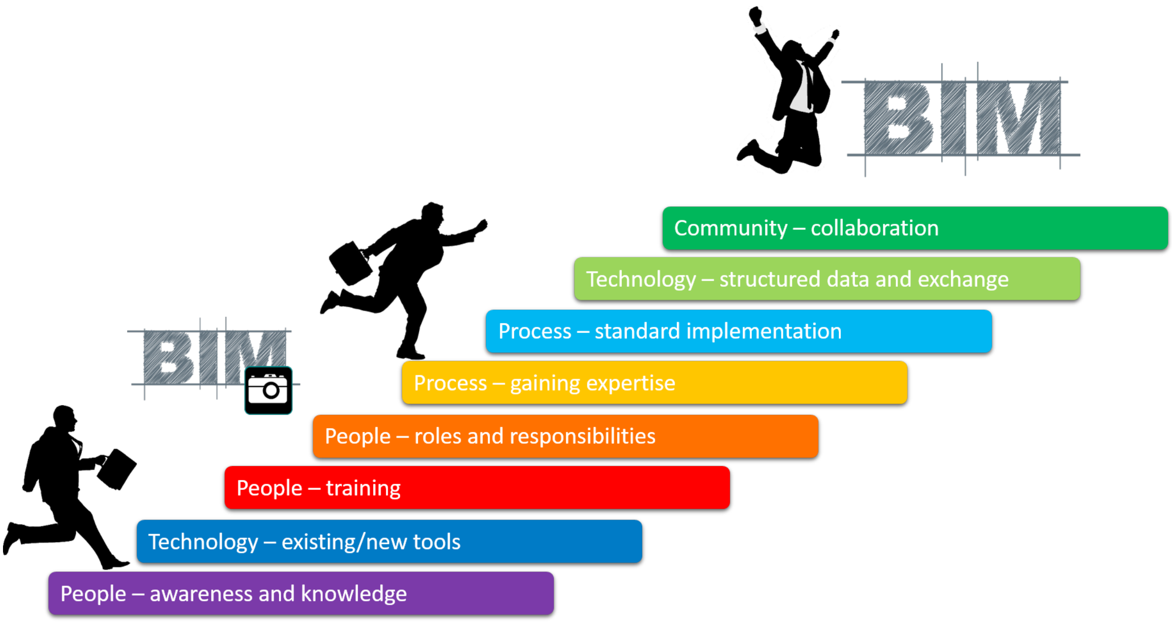
The lead modeller from each of the design disciplines. Discipline BIM coordinators are responsible for ensuring that their models comply with the BIM execution plan. They lead the coordination activities for their respective teams.

During the construction phase, each subtrade that is inputting to the construction BIM should have a BIM coordinator. This role is sometimes referred to as a model manager.

MODEL ELEMENT AUTHOR

The model element author is part of the modelling team, primarily responsible for developing the BIM and associated deliverables in accordance with the BIM execution plan. On small projects, the model element author may also be the discipline BIM coordinator.

The steps to BIM



Start with reviewing your organisation's capability and incentive for change: Begin by raising awareness of what BIM means and generating interest in your organisation. These are the first steps in changing the culture of the business to operate in the BIM environment.

- Review your technology, what you can work with and plan for the future. BIM doesn't necessarily mean you have to go out and buy new software or IT. Assess what you have, determine what you want to achieve and then plug the gaps as appropriate. BIM is not a set of software but does require a suite of tools to help you operate in the BIM environment.
- Start investing in your people and upskill. Start the journey with staff in providing training to understand the terminology, better understand the benefits, and understand the process and what it means to deliver in a collaborative way.
- Understand and develop your roles and responsibilities. Now you have the training, do you have the right people in the right roles and do they understand what their responsibilities are? More importantly, have you got champions for BIM in the business who will continue to push the benefits and change to BIM practices?

- Do 'snapshot' BIM to gain expertise – choose to work with one or two tools from the BIM toolbox to realise those benefits and gain experience. Create people within your organisation that can champion and drive the change process within your business.
- Define the rules in which you operate and standardise your approach. Build processes and implement BIM so that it becomes part of your everyday operation. Commit to BIM.
- Review your technology and plan for the next step. Set up the way you produce your information that is conducive to collaboration and conforms to the recognised data-share formats (IFC etc.). This ensures you are ready to move into the integrated BIM world and are able to deliver consistent sets of information to the rest of the team.
- Share, collaborate and reap the benefits of BIM. Ensure your teams have the ability to actively collaborate and communicate with the rest of the project team. Do not provide blockers such as IP protection and convoluted process that will slow down the release of data that will benefit the project as a whole. Also be receptive to data from others to inform your design.
- Continue to learn and develop. An organisation working in BIM will continue to learn and grow whilst discovering or developing improved tools/processes to achieve the goals of the project. You need to make sure those learnings are shared not only with your own organisation but to the BIM community as a whole so that the adoption of BIM in the built environment has the best opportunity to be successful.

What stops New Zealand embracing BIM?

LIMITED CLIENT/GOVERNMENT DEMAND

- Limited or diluted client requirements, therefore the project is not taken forward in a BIM environment.
- Not government led – does New Zealand need BIM to be mandated by the government as in the UK for it to grow? (Note: Government as a client is a key BIM acceleration initiative – industry should slowly see this 'roadblock' changing.)

NOT RELEVANT TO THE PROJECT

- Small practices may feel that BIM simply isn't applicable or appropriate to the nature of their workload.
- They feel there isn't the level of complexity to warrant BIM – the project is too simple/small, the wrong type etc.

COST

- Perceived additional cost to the project to perform BIM without looking at investment. What does BIM actually cost?
- Having to buy Revit and change the way we do things. In reality, what are we changing?
- The client doesn't want to pay for something that they believe they have already bought, i.e. collaboration, coordinated design etc.

LACK OF IN-HOUSE EXPERTISE

- The company doesn't have the staff with the necessary skills to create the models.
- Perceived lack of skills and experience in managing information in the BIM environment. But what has changed? Still managing the same information but in a different environment.
- Learning curve for new software. Focus on the digital software capabilities of a company rather than what BIM is trying to achieve.

LACK OF TRUST

- Distrust in the industry.
- Perception of stealing IP or smarts from one company to another.
- Trust in each company or organisation working towards the greater good.

FOLLOWING THE J CURVE

- Expectation and promise of high returns only to experience a drop in capability.
- Beating the learning curve and getting up to speed. All organisations face this challenge when starting on the BIM journey.

What will our industry look like in the future?

Looking to the future, these are just some of the expected outcomes of using BIM. These are what you will hear most commonly when people speak of BIM around the world:

- Constructors and clients will experience improved cost and time savings during the construction process. This will in turn drive greater demand for use of BIM from early stages of designs.
- People will get better and faster at BIM. Levels of skills in the industry will gradually improve, reducing the initial inefficiencies of designing in BIM and encouraging clients to demand more.

- Those who use BIM will deliver faster and more efficiently. The delivery and performance gap will widen between consultants that use BIM and those that don't.
- Consultant round table networks will naturally emerge that will bid for projects as a group rather than individually, passing on the collective benefits to developers.
- Improved user-friendly software and widespread adoption of BIM will have asset owners asking for facilities management models for management of their assets. This will drive greater demand for BIM use on existing buildings and new builds.
- The tighter and more collaborative design processes of BIM will change the way buildings are delivered. We'll see consultant networks joining contractors and partnering clients to deliver their projects together. True integrated project delivery will emerge.
- New legal and contractual frameworks will emerge that manage and balance risk of construction and design as the design and development processes become more collaborative.

Where to go for more information

- BIMinNZ – www.biminnz.co.nz – where you can see the developments of the NZ BIM Handbook and track progress by the government to implement BIM in New Zealand.
- Local BIM groups – groups of like-minded individuals and organisations who discuss BIM development, share experiences and push for wider BIM adoption in their regions. You can participate in BIM discussions, learn from key presenters and get regular updates on the progress of BIM in your region.
  - BIMsiNZ – www.linkedin.com/groups/8564047
  - BIMAK – www.linkedin.com/groups/8424531
  - BIM.WELL – bimwell.wordpress.com/author/bimwell
- The B1M – forum and video library dispelling the myths of BIM. This is UK focused but has a very good human aspect to the implementation of BIM and what it means to the construction industry.
- Productivity Benefits of BIM brochure.
- General internet searches – you can search BIM in Google and get many thousands of hits on BIM.

B1M's Fred Mills answers the question "Why building information modelling (BIM)?" with an open letter to the construction industry from Generation Y – a real chance to change our industry.

Watch video: Dear construction industry…

Glossary

AIM	Asset Information Model – the model prepared and used in the operation stage
BEP	BIM execution plan
BIM	Building Information Model Building Information Modelling Building Information Management
CAFM	Computer-Aided Facility Management
CDE	Common Data Environment
COBie	Construction Operations Building Information Exchange
IFC	Industry Foundation Classes
LOD	Level Of Development
PBB	Project BIM Brief
PIM	Project Information Model – the model prepared and used in the design/construction stage
SMP	Standards, Methods and Processes

Acknowledgements

The NZ BIM Industry Training Group was established in 2015 and followed on from an initiative by BRANZ and the BIM Acceleration Committee (BAC).

NZIOB was then appointed by the BAC to take the lead in rolling out some BIM seminars in New Zealand in cooperation with fellow institutes:

BIM 101: An Insight is the culmination of this work and the first in a series of seminars and handbooks on this subject.

As part of the work we undertook, we discussed the real and perceived barriers to BIM adoption in New Zealand and how we could get maximum industry involvement. This would not have been possible without the acknowledgement and support from a range of industry sponsors who have all chipped in.

BIM industry training group

DENNIS BURNS
CBP NZIOB, DIRECTOR ARCHAUS

Since 1993, Dennis has been a Co-Director of Archaus, With over 40 years' experience in most facets of the New Zealand construction industry, this naturally led to an interest in BIM and integrated project delivery (IPD). The Archaus team is now recognised as both New Zealand and Australian leaders in this field. By utilising the inherent power of modelling buildings in 3D and associated IPD processes, Archaus has achieved a significant increase in productivity during design and construction.

Dennis is looking forward to a future where there is a greater and more consistent uplift in the use of BIM and where consistent standards are more widely implemented. Chairing this industry training initiative, on behalf of the NZIOB, is another step in this journey.

DAVID MCDONALD
BIM MANAGER, JOHN LEEN PLUMBING

As BIM Manager for John Leen Plumbing Ltd based in Wellington, David has a key role with BIM implementation, assessing current systems and processes and developing a strategy for the integration of BIM and enhanced information management processes into the business. He is currently supporting Master Plumbers, Gasfitters and Drainlayers to educate members on BIM adoption and implementation.

CRAIG WATKINS
TECHNICAL SYSTEMS MANAGER, HAWKINS CONSTRUCTION

With a wide range of industry experience covering a variety of roles from site engineering to design and project management in New Zealand and the UK, Craig is leading the development of BIM opportunities within Hawkins Group, having worked on the education public-private partnership (PPP) projects within New Zealand. Craig has a passion for technology within the business and continues to work towards a consistent, lean and collaborative environment.

PETER JEFFS
NZIA, BIM MANAGER, ARCHITECTUS

As the BIM Manager for Architectus in New Zealand, Peter works with project teams to develop BIM strategies to maximise the capabilities of project delivery. He is responsible for driving efficiency and providing solutions to structure and customise the technology to meet the needs of project stakeholders, while also developing and delivering in-house BIM training programmes. Peter supports the wider BIM industry in New Zealand and Australia with his involvement in working groups for various industry BIM initiatives, conferences, training courses and universities and also provides consultancy services to individuals and architectural practices.

GLENN JOWETT
NZIOB, BIM PRACTICE LEAD, AECOM

As BIM Practice Lead for AECOM New Zealand based in Christchurch, Glenn works with clients to implement improved information management solutions, with BIM playing a key role in data collection, verification and transfer. He has played an intrinsic role in establishing BIM best practice for clients in the UK and New Zealand. He is currently supporting a number of significant public and private sector organisations in New Zealand with the implementation of BIM.

KEELEY POMEROY
MNZIQS, SENIOR QUANTITY SURVEYOR, AECOM

Based in Christchurch, Keeley is a 5D BIM and innovation specialist. He has an integral role in the early discussions on numerous projects where BIM has been implemented and has been integral to the adoption of BIM in AECOM's cost management teams. Keeley provides ongoing support for the New Zealand BIM community including training, case studies and presentations. He is the current Chair of the NZIQS BIM Committee.

We would especially like to thank; Archaus, AECOM, John Leen Plumbing, Architectus, & Hawkins for donating our time. Without their support the training group would not have succeeded.