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THE NEW ZEALAND BIM HANDBOOK

A GUIDE TO ENABLING BIM ON BUILT ASSETS
2019 THIRD EDITION

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BIM ACCELERATION COMMITTEE

BRANZ
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HĪKINA WHAKATUTUKI

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This handbook draws on documentation produced by a variety of international parties including: International Organization for Standardization (ISO), NATSPEC Construction Information, Penn State Computer Integrated Construction (CIC) Research Program, buildingSMART, BIM Forum, UK BIM Task Group, BSI Standards Limited (BSI), and Construction Project Information Committee UK.

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Appendices are published separately:

Foreword

Few things have the potential to improve the performance of New Zealand's building, construction and asset operation sectors as Building Information Modelling (BIM). An investigation conducted by the Ministry of Business, Innovation and Employment highlights BIM as the only improvement initiative likely to deliver a step-change, rather than an incremental gain in productivity.

The first edition of this handbook was released in July 2014, following an industry workshop initiated by the Productivity Partnership involving 50 representatives across the construction industry.

Developed in partnership with industry at every step, the handbook is for New Zealand's building and construction sector, but draws on best BIM practice from around the world. The handbook documents a consistent approach, using a common language, to BIM in New Zealand, representing a significant achievement of which contributors to the original handbook should be proud.

Surveys conducted by EBOSS, and other anecdotal evidence, point to a healthy uptake and understanding of BIM in New Zealand. Industry training and more knowledgeable clients add further impetus to industry's adoption of BIM.

This is the third edition of the handbook. It provides more information on BIM for construction, facilities management and linear infrastructure. Reference is made to the recently released standards ISO 19650 parts 1 and 2. Other document references have been updated to reflect the latest editions.

The aim of this handbook remains unchanged: To capture the many benefits of BIM to encourage its use and to create, maintain and operate quality built assets in New Zealand.

BIM adds value to the whole life of a built asset, from pre-design to operation. It paves the way for the application of modern digital technologies to the briefing, design, procurement, construction, handover and operation of an asset.

This edition of the BIM handbook continues to promote the use of BIM and its benefits to the built asset creation and operation sectors. Our thanks to everyone who had a hand in its development.

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1— Introduction

1.1 BIM defined

BIM is the sharing of structured information.

BIM (Building Information Modelling) definitions vary across designers, constructors, and operators. The New Zealand BIM Acceleration Committee offers the following definition:

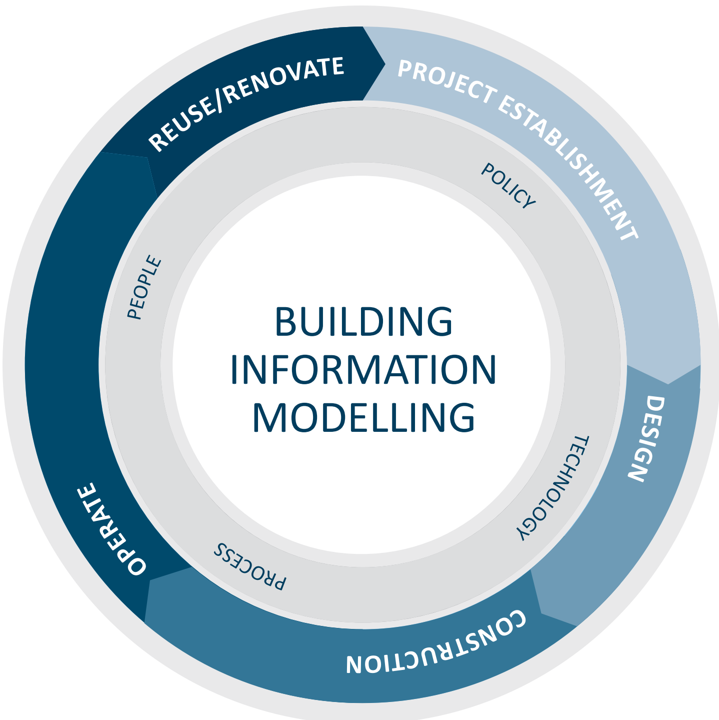
BIM is a coordinated set of processes, supported by technology, that add value through the sharing of structured information for buildings and infrastructure assets

BIM typically includes information on design, construction, logistics, operation, maintenance, budgets, schedules, and much more, providing a far richer environment than traditional approaches. Information created in one phase can be passed to the next phase for further development and reuse.

BIM is not any single act or process, nor is it a 3D model in isolation, or computer-based fabrication. BIM is being aware of the information needs of others as you go about your work.

BIM – better building process, building better performance

FIG 1.
THE PROJECT LIFE CYCLE



1.2 Purpose of this handbook

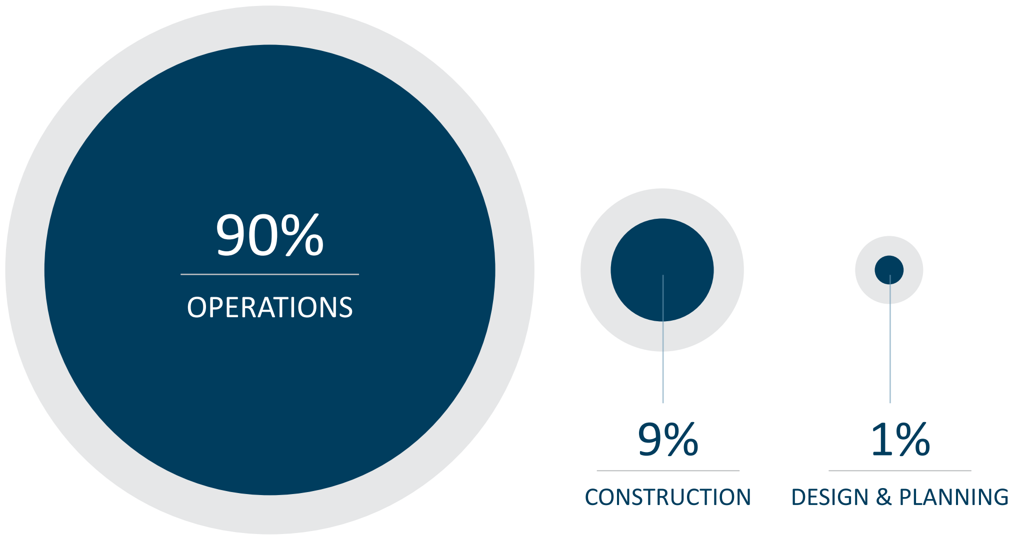
This handbook, created by the BIM Acceleration Committee, aims to create a New Zealand-centric document to:

- Promote the use of BIM throughout the asset life cycle
- Create a common language for industry
- Clarify the briefing process for design consultants and constructors
- Improve coordination in both design and construction phases
- Promote a more proactive approach to facilities management
- Create a clear path for industry's continuing development
- Promote BIM's value to clients and the supply chain to change behaviours for the better

Design and construction sectors have matured their understanding of BIM. Now, the facilities and asset management (FM/AM) industry is latching on to the benefits of using information generated during design and construction phases.

This handbook outlines critical inputs from FM/AM providers that will ensure BIM delivers the information they need, in a format that they can use.

FIG 2.
PROPORTIONAL SPLIT OF WHOLE OF LIFE COSTS OF AN ASSET



BIM processes apply to creating and operating all types of assets, including buildings, industrial facilities, and civil infrastructure. Though still developing, BIM has been used in industrial and civil projects for more than 20 years. This handbook was first written with a focus on buildings/vertical infrastructure. In this edition the authors have included terminology and processes for horizontal infrastructure assets.

Geospatial information from survey tools is a key input to BIM. Section 5.9 covers the production and formatting of 3D survey information for BIM.

1.3 Handbook structure

The handbook traces the progression of a typical project:

- Project establishment/briefing
- Design
- Procurement
- Construction
- Handover
- Operation

Find BIM planning documents and more details on aspects of BIM workflow in the appendices.

1.4 Benefits of adopting BIM processes

BIM supports feasibility, planning, design, construction, and operation stages of the project lifecycle. Approaching these processes as a whole supports more coordinated information sharing that enhances the overall benefits of BIM.

FIG 3.
INDICATIVE OPPORTUNITIES TO LEVERAGE BIM ACROSS VARIOUS PROJECTS TYPES

PROJECT TYPE	PLAIN LANGUAGE BENEFITS	KEY BIM OPPORTUNITIES	PRIMARY BIM USES (REFER APPENDIX D)
Residential (single and multiple dwelling)	• Stronger marketing pitch to potential buyers and real estate agents • More efficient prefabrication of repeatable units	• Provide potential owners with a virtual view of the completed facility. Includes preliminary models	• Design review • Design authoring
Commercial (office, retail etc.)	• Present tenants and owners with a vivid picture of proposed developments • Reduce changes in design and construction phases	• Design collaboration produces coordinated designs • Leverage models produced for analysis and cost management • Improve stakeholder engagement as design develops	• Cost estimation • Design review • Design authoring • Engineering analysis • Structural analysis • 3D Coordination
Institutional (healthcare, transport terminal etc.)	• Engage multiple non-technical stakeholders • Improve design and construction efficiency • Reduce unexpected changes in construction due to heavily serviced nature of these facilities • Leverage model and information to assist with FM/AM	• Design collaboration produces better coordinated designs • Leverage models for analysis and cost management • Improve stakeholder engagement as design develops • Update models with non-graphical asset information during construction • Feed updates into ongoing facilities management	• Cost estimation • Design review • Design authoring • Engineering analysis • Structural analysis • 3D coordination • Record modelling • Asset management
Infrastructure (road, water network etc.)	• Engage multiple non-technical stakeholders • Improve design & construction efficiency • Reduce unexpected changes in construction due to heavily serviced nature of these assets • Leverage model and information to assist with network maintenance • Link operational data to monitor planned vs actual operating characteristics	• Link coordination and planned additions and upgrades to existing network • Use phase planning of work to understand impacts on users • Update models with non-graphical asset information during construction • Feed updates into ongoing facilities management	• Existing conditions modelling • Cost estimation • Phase planning • Site analysis • Design review • Design authoring • 3D coordination • Record modelling • Asset management

Shared understanding of overarching objectives is key to project success.

PROJECT OBJECTIVES

Shared understanding of overarching objectives is key to project success. Record and document objectives approved by stakeholders during feasibility and planning stages of a project.

Start with a BIM brief, identifying specific BIM uses that will help meet project objectives **(refer BIM uses: Appendix D.)** Project participants should add BIM uses that are likely to benefit the project. For example, a structural engineer could select BIM to undertake analysis.

The 21 BIM uses are defined in **Appendix D.**

Common BIM uses and terminology in the New Zealand industry:

Design coordination

- Models are comprised of virtual systems, components, and elements. Models show ownership, spatial and functional relationships
- Relationships between elements are updated as the model evolves
- Drawings are derived from a model by viewing it from a preferred vantage point, including 'slicing' to produce plans, sections, and details
- Models can be combined to form a single federated model that illustrates the relationship between systems, elements, and components produced by independent model authors (refer 2.1 BIM definitions, figure 5).
- A coordinated model leads to more coordinated construction, reducing waste, and boosting efficiency

Communication

- People immediately grasp 3D models and images, helping reduce the potential for misinterpretation inherent to 2D images
- BIM improves communication between stakeholders, including clients, building authorities/ assessors, local communities, and contractors
- BIM provides an opportunity to engage clients, contractors, and other stakeholders much earlier in the design process – when their inputs deliver the greatest value
- BIM provides inputs for virtual and augmented reality viewing of a model, helping viewers grasp spatial relationships and final appearances

Information management

- Non-graphical information, such as schedules, dimensions, volumes, and attributes, can be added to a model, or even generated in a model
- Modelling software manages graphical information associated with each element of an asset. Graphical information is updated automatically as the model is changed
- Schedules produced from the model reflect the current state of the model/project/asset
- BIM information is digital, which by nature is easily stored and transmitted, and readily searched, sorted and filtered
- Connections and APIs support the flow of information between models and spreadsheets

Analysis and simulation

BIM models make it easy to accurately re-calculate performance following changes, encouraging further exploration and optimisation of different design options. Information associated with a model has many uses:

- Quantity take-off and costing
- Simulating aspects of the proposed asset's behaviour, such as structural, thermal, acoustic, lighting, and fire performance

- Effective option analysis during the early stages of a project to support more informed decision making by stakeholders, prior to committing to capital cost
- Linking automated and generative design processes. Note, the benefits, opportunities, and risks associated with design automation are beyond the scope of this handbook
- Analysing design information/model during the safety in design review process to improve the construction and operational safety of an asset
- Allowing owners/operators/constructors to interact with an asset in a virtual environment, prior to build

Improved productivity during construction

BIM improves construction quality and on-site safety, shortens construction programmes, and reduces costs, thanks to:

- Better planned site activities and optimisation of the construction sequence
- Quicker and more accurate set-out
- Greater off-site prefabrication, allowing elements to be modelled, documented, and manufactured with greater precision
- Using digital model files to link computer-controlled fabrication equipment and site machinery

Better information for asset management

Different assets require different sets of information for effective management of their lifespan. Involving asset managers/asset operators at the project establishment and BIM briefing stages of a project can be extremely helpful, and even benefit design.

BIM information generated during design and construction phases is readily transferable to asset managers, promoting more effective use and maintenance of assets. Capturing this information in digital formats is more effective than traditional paper-based methods.

1.5 BIM in New Zealand

Design teams working on big complex projects typically design and document in 3D, which greatly improves coordination, reduces rework on site, and assists digital handover of As-Built information to asset owners.

More contractors require suppliers to provide construction phase BIM inputs. The ability of some suppliers to adequately support a BIM project in New Zealand is improving, but still limited. Clients should remain wary when selecting design and construction teams. Following processes for preparing a project BIM brief and reviewing the BIM evaluation and response template will help ensure the delivery team's capabilities will meet client needs.

More projects today require a contractor to maintain BIM throughout the construction phase, and provide an As-Built or record model at handover and key milestones, such as covering in buried works.

Maintaining a model during the construction phase can be undertaken by the contractor, or as an extension to the designer's scope.

The intent of this handbook is to support further development. Specifically to:

- Help clients to understand the benefits of BIM so they can better brief their design teams
- Provide a common framework for designers and constructors to respond to BIM procurement requests
- Create a common language so that owners, designers, and constructors understand what they are being asked to provide
- Outline processes to efficiently implement BIM on a project
- Offer a framework for people new to BIM to help them understand what's involved and how they will benefit

1.6 Global BIM

New Zealand needs to operate on the international stage and leverage international developments. Accordingly, this handbook references international standards, codes, and guidelines, including the ISO 19650 international standard (previously the PAS 1192-2 document from the UK), the Natspec documents from Australia, and Penn State BIM execution planning documents from the US. Where possible, the handbook uses internationally accepted language and work flows. Commonly used terms are included in the glossary.

While BIM processes have been mandated in some countries, at the time of writing the New Zealand government had not mandated BIM. However, in supporting the BIM Acceleration Committee, and assisting government clients to adopt BIM, the government is behind the development and uptake of BIM in New Zealand.

1.7 ISO 19650 Parts 1 and 2

Details in the ISO 19650 standards are beyond the intent of the NZ BIM handbook. The standards also use terms rarely used in New Zealand (Appointing party = client; lead appointed party/appointed parties = consultants and contractors). Key ISO 19650 terms are included in the NZ BIM handbook glossary to help readers interpret international publications using unfamiliar terms.

ISO 19650 Part 1 defines terms and structure for managed information exchange. Part 2 outlines detailed workflow for information management during the eight stages of the asset delivery phase:

1. Assessment and need
2. Invitation to tender
3. Tender response
4. Appointment
5. Mobilisation
6. Collaborative production of information
7. Information model delivery
8. Project close-out (end of delivery phase)

Each stage comprises up to eight defined activities.

Process, workflows, and activities recommended in this handbook are consistent with ISO 19650. They are presented in a format that will be routine to users familiar with project delivery in New Zealand.

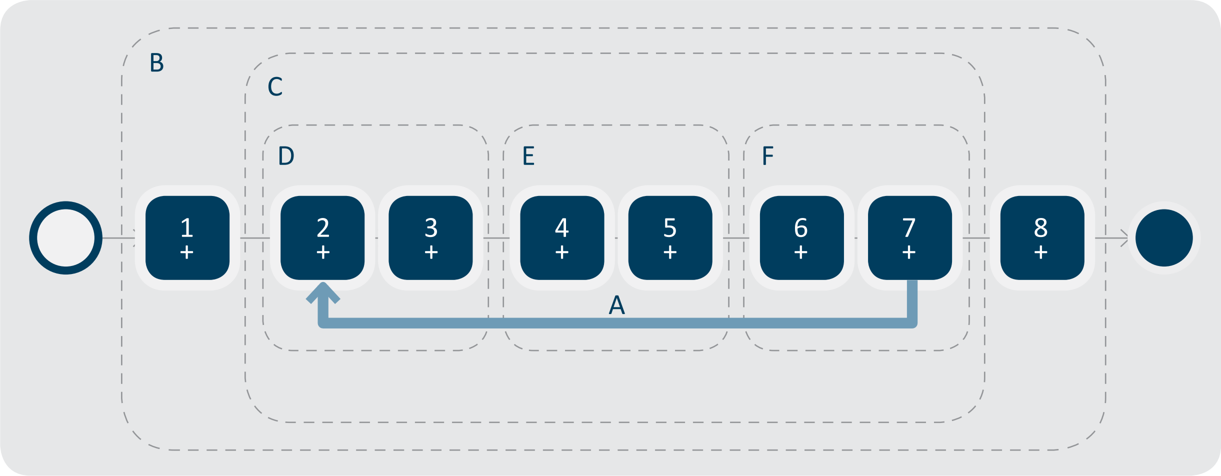
1.8 BIM and the NZCIC design documentation guidelines

This handbook incorporates elements of the New Zealand Construction Industry Council's (NZCIC) design documentation guidelines. Whereas the BIM handbook is the key reference document for BIM-centric projects, the NZCIC design documentation guidelines focus on the responsibilities of parties involved in phase-by-phase establishment, design, and construction.

The August 2016 version of NZCIC's design documentation guidelines include references to BIM, providing a high-level approach to implementing BIM. The BIM handbook provides more detail, with specific project requirements contained in the BIM execution plan. Note that the NZCIC guidelines are specifically aimed at building-type projects.

FIG 4.
INFORMATION MANAGEMENT DURING THE DELIVERY PHASE OF ASSETS
ISO 19650-2:2018(E)

The information management process shall be applied throughout the delivery phase for each appointment, regardless of project stage.



ACTIVITIES

1 assessment and need
2 invitation to tender
3 tender response
4 appointment
5 mobilization
6 collaborative production of information
7 information model delivery
8 project close-out (end of delivery phase)

A information model progressed by subsequent delivery team(s) for each appointment
B activities undertaken per project
C activities undertaken per appointment
D activities undertaken during the procurement stage (of each appointment)
E activities undertaken during the information planning stage (of each appointment)
F activities undertaken during the information production stage (of each appointment)

1.9 BIM and procurement

Project procurement strategy impacts the way BIM is enabled and managed. However, regardless of procurement strategy, the client must first define their objectives as they relate to digital information during design, construction, and operation phases. Potential project participants should be made aware of these objectives before they are contracted.

BIM's many benefits focus on improved collaboration between project participants. These benefits increase when procurement strategy promotes collaborative approaches.

Regardless of procurement strategy, the client must first define their objectives as they relate to digital information during design, construction, and operation phases. Potential project participants should be made aware of these objectives before they are contracted.

Design, bid, build: Contracts should assist designers to take a more collaborative approach. Everyone must agree who models what, and when. Contractors bidding for work must understand the nature and completeness of the models they will receive.

Design and build, or ECI: These stages present designers and constructors with the opportunity to work together to ensure things are modelled only once. Including specific elements in design stage models rather than generic will produce a more efficient design.

Collaborative contracting or integrated project delivery: Linking the client, designers, and constructors to common objectives will maximise the benefits of BIM processes. However, all parties must trust each other implicitly.

Learn more on the BIMinNZ.co.nz website 'Collaborating with BIM Think Piece'.

2— BIM basics

2.1 Definitions

This section includes key BIM terminology. It overviews relationships between key documents and roles in BIM. Find links to referenced documents on the BIMinNZ website. A glossary of BIM terminology is provided at the end of this document.

BIM USES

BIM covers a number of processes or tasks, such as design authoring and 3D coordination. This handbook categories these tasks as BIM uses, in the process creating a common language. The NZ BIM handbook contains 21 separate uses, sourced from the Penn State BIM Execution Planning Guide, though with minor terminology changes to match the New Zealand context. Some uses are commonly applied to projects, whereas others simply indicate possible applications of BIM in the future.
BIM uses are defined Appendix D.

MODELS AND FEDERATION

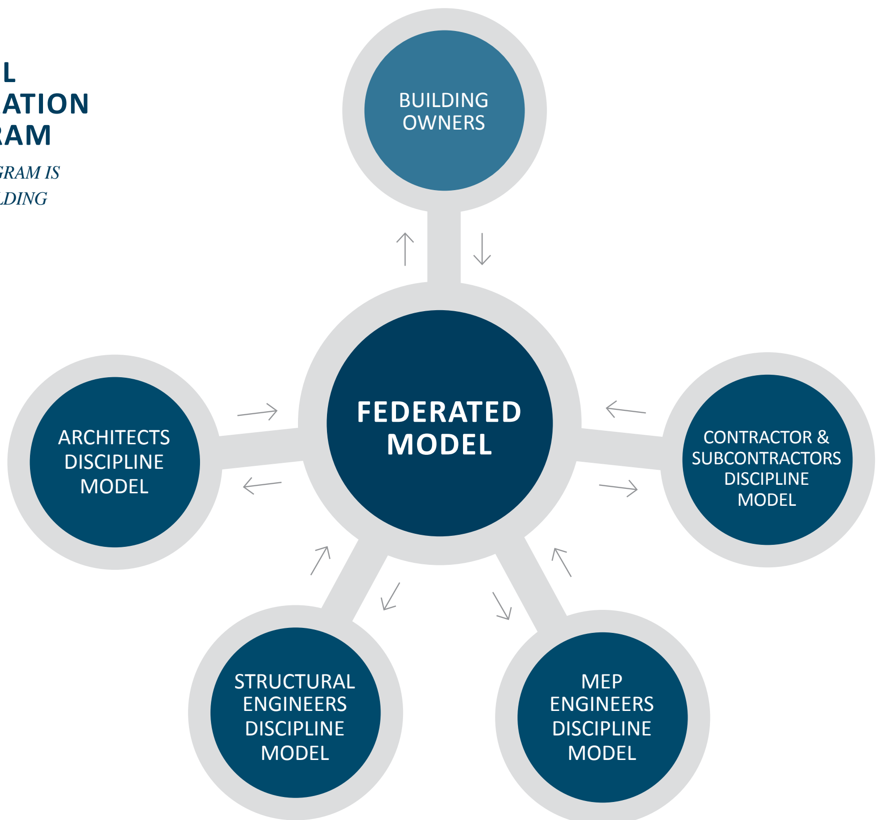
In most cases, each designer or sub-trade will produce their own project model. Individual models can be combined, or federated, to create a composite model.

However, when creating a federated model, the information exchange and file format compatibility and interoperability should be documented in the BIM execution plan.

This will ensure geometry and/or information are managed in compatible file formats to support file sharing between project members and, in the process, smooth workflow. Models exist in different formats. Federated models aren't tied to specific authoring software.

Interdisciplinary coordination is confirmed in the federated model. Changes are made in individual discipline models. On large projects, splitting discipline models into multiple smaller models makes file sizes more manageable.

FIG 5.
MODEL FEDERATION DIAGRAM
**THIS DIAGRAM IS FOR A BUILDING PROJECT*



BIM DOCUMENTS

Project BIM brief

Developed by the client before the project team is engaged, the project BIM brief is a subset of project requirements or equivalent contract documentation. The brief introduces client objectives, information requirements, BIM uses, reasons, and purpose to the project team. It also includes technical and commercial details that should be addressed during the implementation of BIM.

The project BIM brief should include detail that enables the project team to adequately assess both commercial and programme implications of a client's BIM requirements. Requirements should be included in the project contract and implemented through a BIM execution plan. Refer Appendix E.

BIM evaluation and response template

The BIM evaluation and response document is a supplemental template to the project BIM brief in the RFP or contractor procurement stage. It is designed to provide a consistent framework for the BIM component of a response to a request for proposal, demonstrating how the potential project team member will meet requirements specified in the BIM brief. Scored by tender evaluators, the template is pivotal to the selection of the project team. Refer Appendix G.

Project BIM execution plan

The key document for successfully executing BIM, the BIM execution plan expands on the project BIM brief. Developed by the project team prior to commencing design, the execution plan is a live document updated throughout design and construction phases. Expanding on client objectives and outlining how the project team will achieve them, the execution plan allocates key responsibilities and defines critical processes, procedures, and tools. When the design phase is completed, the project BIM execution plan is included in construction tender documentation, and passed from the design team to the construction team. Together with construction phase BIM processes, procedures, and tools, sharing this information ensures the construction team understands the extent of model development during design. Refer Appendix H.

BIM ROLES AND FUNCTIONS

BIM manager

Clients typically appoint an Information/BIM manager before the design team is engaged. In some cases the lead consultant can assume all or part of the responsibilities of a BIM manager.

BIM managers are responsible for satisfying project objectives as they relate to BIM uses, information, and BIM. Broad responsibilities include:

- Facilitate the development of a project BIM brief
- Brief project stakeholders
- Develop the project BIM execution plan
- Maintain and revise the BIM execution plan during the project
- Communicate progress to project stakeholders
- Tackle BIM issues in a timely and efficient manner
- Audit models received from project stakeholders to ensure geometry and information develops according to BEP and project requirements

- Coordinate federated models
- Detect, report and allocate responsibility for resolution of clashes
- Facilitate coordination meetings
- Communicate coordination issues to project stakeholders
- Support the client and the project to ensure BIM requirements are followed and BIM-related project goals are achieved

Projects with a lead consultant could split BIM responsibilities which must be clearly delineated. A client-side BIM manager will focus on briefing, defining, and information, while the lead consultant BIM manager will focus on execution, coordination, and federation.

Discipline BIM lead

Each discipline (architect | structural engineer | services engineer etc.) should appoint a BIM lead to manage BIM-related activity. Broad responsibilities include, but are not limited to:

- Participate in BIM execution planning
- Participate in design review and model coordination meetings
- Facilitate the use of the BIM execution plan within their organisation and teams
- Ensure model files develop according to the project BIM execution plan
- Validate levels of model development at each project stage
- Perform detailed model audits before they're shared with the wider team
- Communicate issues to model element authors
- Implement internal coordination and clash detection procedures
- Manage model transfer and version control
- Maintain knowledge of BIM for relevant disciplines

Model Element Author (MEA)

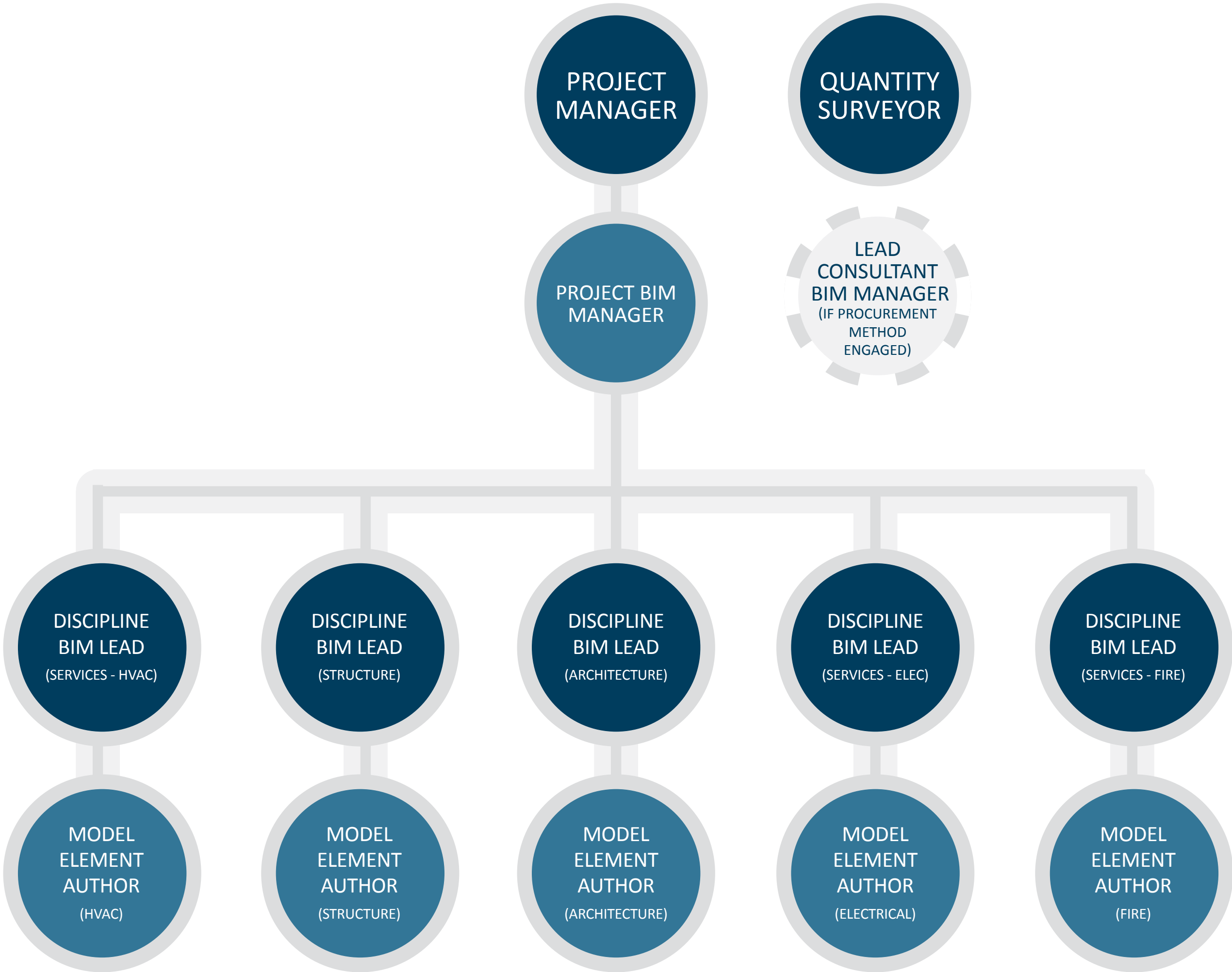
A model element author is the project participant responsible for developing the building information model during the project delivery process. Model element authors are tasked with facilitating BIM uses and BIM goals.

Broad responsibilities include:

- Determine model elements in the MEA & BEP
- Develop model elements to appropriate levels at each project stage
- Communicate issues to project participants

FIG 6.
KEY PERSONNEL AND BIM ROLES

BIM organisational structure and lines of reporting for key project personnel in design phase for a buildings project.



2.2 BIM and project management

Implementing BIM on a project does not replace project management. The project BIM brief and BIM execution plan should supplement, rather than duplicate, project management documentation. Project managers must retain overall control of the project programme, deliverables, and communication.

3— Legal implications of BIM

Information contained in this section is guidance only. Seek legal advice when developing and executing contracts.

CONSULTANT SELECTION

Project consultants should be provided with the project BIM brief and other project information during the Request for Proposal (RFP) process. The RFP must clearly outline the client's BIM-related expectations of the consultant. Expectations should focus on specific BIM goals and benefits that the client has identified. The inclusion of BIM activities for the benefit the consultant (e.g. analysis) are secondary.

When clients have the opportunity to review the BIM evaluation and response document they're in a better position to select a team with critical skill aligned to BIM delivery methodologies required for the specific project.

> The project BIM brief and the BIM evaluation and response template, along with other parts of the RFP, are vital elements of the consultant engagement contract. Take care to avoid contradictions between various documents when assembling the contract. Provide a clear order of precedence.

The RFP must detail how the BIM process will be managed and the responsibilities of individual parties. Ideally the role of the BIM manager will be specifically detailed rather than combined with the general lead consultant role description. Functions may be performed by the same organisation, but the requirements and skills of each role are separate.

When the scope or responsibilities of an organisation change during the development of the project BIM execution plan (a collaborative exercise after the consultants have been engaged) they should be treated in the same way as other scope changes under the contract.

Consultant responsibilities for timeliness, completeness, and quality of deliverables are no different under a BIM delivery method. The contract (including project BIM brief and/or BIM evaluation and response documents) must clearly state deliverables and dates. However, BIM processes involve more interdependencies, which must be factored into the delivery programme.

CONTRACTOR ENGAGEMENT

The Request for Tender (RFT) process must clearly outline the client's BIM expectations of the contractor. Expectations should focus on specific BIM goals and benefits identified by the client. BIM activities for the benefit of the contractor (e.g. scheduling) are secondary.

Issuing design models to the contractor at the time of tender and, subsequently, as a part of the contract can greatly improve an end-to-end BIM process, which will lead to improved project outcomes.

The project BIM brief should be included in the RFT process and cover the following BIM information and tasks:

- Confirm the models, format, and level of development and information to be provided to the contractor from the design team
- Design BIM execution plan
- Confirm that either the design BIM manager will be retained during the construction phase, or the contractor will be required to provide a person for this role
- Define the handover process from design to construction BIM manager
- Agree format and level of development required for handover models to the client/operator
- Agree format and asset information required for handover to the client/operator

INTELLECTUAL PROPERTY AND MODEL DISCLAIMERS

The exchange of models is the very basis of the BIM process. There is more dependency between the documentation of the design disciplines during the design phase, and sub-trades during construction. Users need to understand the degree to which they can rely on the models they receive. In the interests of fostering true collaboration across the life cycle of an asset, avoid using blanket “for information only” disclaimers. The issuer of a model must clearly define what it can (and can’t) be used for. For example:

- Work in progress – issued for ongoing coordination
- Developed design issue
- Detailed design issue for consent and contractor pricing
- Issued for construction – for production of shop drawings, not for fabrication
- Issued for construction – suitable for fabrication.

These classifications can be defined in a **Model Description Document, or MDD** (refer Appendix J). Models should also be read in conjunction with the BIM execution plan, which defines BIM uses that can be applied to the model at a given project stage, and with other project documentation, including specifications and schedules.

Models can contain far more information than traditional electronic deliverables. To maximise the benefits of BIM, this information must be freely available to others. Most standard forms of contract cover the ownership of intellectual property.

The Conditions of Contract for Consulting Services (CCCS) 2017 covers the ownership of deliverables. For BIM documents this can be interpreted as:

- Models created for the project are ‘new IP’ and jointly owned by the client and consultant. Each party grants the other an unrestricted royalty-free license to use the model. The client can make the complete models available to the project team for any project-related use. The client’s rights with respect to new IP are conditional on the client paying all amounts due to the consultant.
- Specific modelled element details and libraries are ‘pre-existing IP’. Ownership remains with the consultant. The consultant grants the client an unrestricted royalty-free license to use the specific element details and libraries “to the extent reasonably required to enable the client to make use of the service or to use adapt, update, or amend the works”.
- The client can use the models created for whatever purpose they want, but can only use the specific element details to complete the specific project.

4— Client information requirements

Information about an asset is a key part of the BIM process. From briefing to design, construction through to fabrication, installation, and commissioning, the Building Information Model often contains a huge amount of information.

Most asset owners have a variety of information on their current assets stored in a range of Asset Management Systems (AMS). These systems include computer-based asset databases and paper based systems. Before initiating a BIM process, clients must consider information that is valuable to them and their long-term project and organisational requirements. They should also consider how this information needs to interact with their current systems.

Clients should develop a holistic asset information strategy independent of currently planned projects. In developing the strategy, they should consider both current and future information requirements.

4.1 Information

Assets contain a huge number of individual objects, and related object information. Avoid the temptation to collect all the information for every object within an asset. Collecting and auditing information during both the creation of the asset and ongoing storage and maintenance is costly. Avoid information overload by defining an asset and the related information important to its management.

Avoid the temptation to collect all the information for every object within an asset. Collecting and auditing information during both the creation of the asset and ongoing storage and maintenance is costly.

4.2 Asset information requirements

Clients should work with all parts of their organisation, such as operations, FM/AM, finance, and compliance, to develop their Asset Information Requirements (AIR). The client must communicate their AIR to other parties involved in the creation or maintenance of their assets. Refer Section 5 of ISO 19650-1 for more details. Focus on the following aspects when developing an AIR:

- Compliance and regulatory requirements
- Capacity and utilisation management
- Normal operations information
- Predicted and actual impacts, including energy, waste, and carbon
- Maintenance, repair, and replacement requirements
- Future renovation or eventual disposal requirements

4.3 Information structure

Along with specifying information related to objects within an asset, the client team needs to confirm how this information will be provided.

A number of standard information schemas are being developed and used globally. Omniclass, Uniclass, and CBI are examples of asset classification systems. Construction Operations Building Information Exchange (COBie) is an overall asset structure for a facility or a campus.

The New Zealand Metadata Standards have been developed to provide a standard format and structure for asset information. These standards can be used as a shopping list for asset information. But keep in mind that specified requirements should be proportionate and valuable to your specific needs.

4.4 Information requirements and BIM

Certain information, such as physical location, unique ID, and predicted performance, is a by-product of the design and model authoring process. Other information, such as manufacturer details, warranties, and commissioning, must be added during delivery.

Both the structure of objects within the BIM and the structure of information within each object needs to be consistent for easy importation to AM or CAFM systems. On this front, better modelling practices and standard information structures (information schemas) smooth the way for information exchange.

Appendix A provides more information on modelling best practice.

Each object should include the following information:

- Unique identifier
- Location
- Designed performance
- Installed performance
- Commissioning information
- Manufacturer details
- Warranty details.

Object information should be referenced in the BEP

The following is a workflow example specifying the information requirements for an asset.

FIG 7.
ASSET INFORMATION REQUIREMENTS EXAMPLE

PROJECT ESTABLISHMENT		DESIGN		CONSTRUCTION	HANDOVER	OPERATE
PLAIN LANGUAGE:						
State what you want & why Information requirements: Asset **BY WHO:** CLIENT	**Plan how & when you want it** Information delivery planning **BY WHO:** CLIENT/PM/BIM MANAGER/FEASIBILITY TEAM	**Plan how to deliver it** **BY WHO:** PM/ BIM MANAGER/ DELIVERY TEAM	**Do the work and review it** **BY WHO:**	**Supply, install and commission it**	**Deliver it Approve it** **BY WHO:**	**File archive information** Operate and maintain live information **BY WHO:** CLIENT

OBJECT: HEAT GENERATION SYSTEM

		DESIGN		CONSTRUCTION	HANDOVER	OPERATE
GRAPHICAL INFORMATION:	**MEA (Model Element Authoring Schedule)** • What elements • Delivered by whom • Delivered by when • Delivered to what LOD					
NON GRAPHICAL INFORMATION:		WHAT INFORMATION:				
	Asset information requirements • What elements • Delivered by whom • Delivered by when	**ID: 402010** Category: Make: Model: Location: Room: Design performance: Install performance: Install date: Install by who: Services: Condition: Utilisation: Demand load: Replacement cost: Condition: Commissioning details:	**ID: 402010** Category: HVAC - - Location: B7 Level 1 Room: 851 Design performance: XYZ - - - - - - - - - -	**ID: 402010** Category: HVAC Make: Mitsubishi Model: FCU 659 Location: B7 Level 1 Room: 851 Design performance: XYZ Install performance: XYZ Install date: 2019-3-1 Install by who: XYZ - - - - - - -	**ID: 402010** Category: HVAC Make: Mitsubishi Model: FCU 659 Location: B7 Level 1 Room: 851 Design performance: XYZ Install performance: XYZ Install date: 2019-3-1 Install by who: XYZ - - - - - - -	**ID: 402010** Category: HVAC Make: Mitsubishi Model: FCU 659 Location: B7 Level 1 Room: 851 Design performance: XYZ Install performance: XYZ Install date: 2019-3-1 Install by who: XYZ Services: XYZ Condition: XYZ Utilisation: XYZ Demand load: XYZ Replacement cost: XYZ Condition: XYZ Commissioning details: XYZ
DOCUMENTATION:						
	Project requirements • Drawings • Specifications • Testing information • Install information	Design drawings Specification	Design drawings Specification	Design drawings Specification	Design drawings Specification Installation diagrams	Design drawings Specification Installation diagrams
INPUTS:						
	LOD specification by BIMForum D3020.10 NZ metadata standards or similar					

5— Typical BIM workflow

A typical BIM workflow centres on the information delivery cycle, depicted in figure 8. This diagram is based on the PAS1192-2:2013 specification for information management in the capital/delivery phase of construction projects using BIM. The diagram has been modified for the New Zealand market.

5.1 Information delivery cycle

The information delivery cycle has two distinct starting points:

1. **CAPEX start –** for stand-alone new-build projects, where the focus is on capital delivery efficiencies rather than ongoing operational requirements. The CAPEX start commences with the development of the project BIM brief.
2. **OPEX start –** for projects part of a larger asset portfolio, or for projects involving existing assets. The OPEX start commences with the FM/AM plan, and draws on information from the existing asset information model.

Figure 8 outlines 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 relevant to the project's needs.

Project information models are defined as all the information required to design and construct an asset. This information can include graphical models, documents (drawings, schedules, etc.) and information.

Asset information models are defined as all the information required to provide a service to operate and maintain an asset. This information can include graphical models, documents (drawings, warranties, product manuals, etc.) and information.

Models and associated documentation and information supporting project-specific BIM use requirements should be developed according to NZCIC design stages.

The information delivery cycle is bound by the **Common Data Environment (CDE)**, which is used to collect, manage, disseminate, exchange, and retrieve project information throughout the project life cycle.

The CDE guides information exchange between project stakeholders at milestones agreed in the project BIM execution plan.

5.2 Project BIM brief

This is an important element of project BIM implementation. Developed by the client prior to engaging the consultant team, the project BIM brief forms part of the wider set of procurement documentation. For clients inexperienced in BIM, the project BIM brief should be developed with the help of a suitably experienced professional, such as the project manager, lead consultant, or Information/BIM manager.

The project BIM brief is a subset of the project requirements, or equivalent contract documentation. It introduces the project team to information requirements, reasons, and purpose, along with technical and commercial details that should be addressed through the implementation of BIM.

When developing the project BIM brief, clients should evaluate overall project goals and objectives, in conjunction with the information delivery cycle start point, and consider how a BIM approach will help achieve project goals.

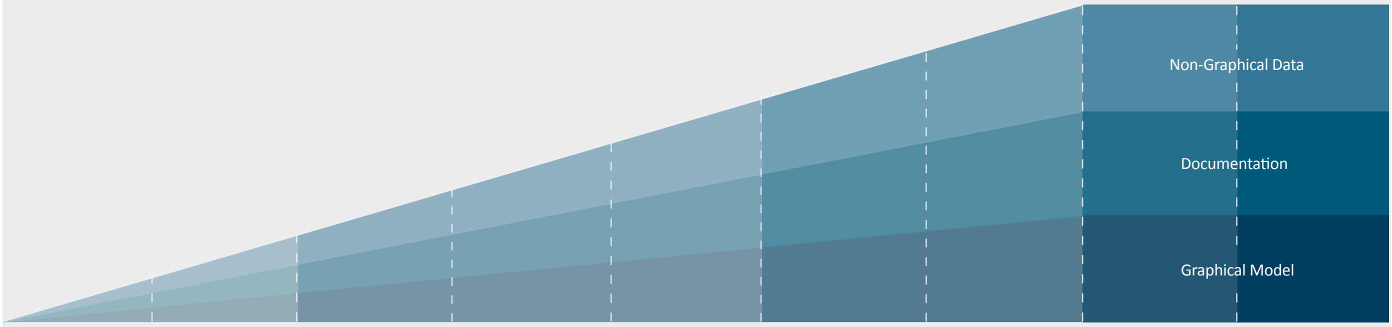
Identify specific BIM uses and deliverables that relate to each project goal. The client should consider both the benefits and likely associated costs when finalising BIM uses.

Find a project BIM brief template in Appendix E.

FIG 8.

THE INFORMATION DELIVERY CYCLE

COMMON DATA ENVIRONMENT (CDE)



PROJECT ESTABLISHMENT					DESIGN – CONSTRUCTION		HANDOVER	OPERATE
PLAIN LANGUAGE:								
State what you want & why Information requirements: • Organisational • Project • Asset **BY WHOM:** CLIENT	**Plan how & when you want it** Information delivery planning **BY WHOM:** CLIENT/ PM/BIM MANAGER/ FEASIBILITY TEAM				**Plan how to deliver it** **BY WHOM:** PM/BIM MANAGER/ DELIVERY TEAM	**Do the work and review it** **BY WHOM:** DELIVERY TEAM	**Deliver it Approve it** **BY WHOM:** DELIVERY TEAM	**File it** **BY WHOM:** CLIENT
ACTIVITIES (ISO 19650):								
0. IDEA	**1. ASSESSMENT & NEED** (ISO 19650 Section 5.1)	**2. REQUEST FOR PROPOSAL (RFP)** (ISO 19650 Section 5.2)	**3. RESPONSE TO RFP** (ISO 19650 Section 5.3)	**4. PROCURE or APPOINTMENT** (ISO 19650 Section 5.4)	**5. MOBILIZATION** (ISO 19650 Section 5.5)	**6. COLLABORATIVE PRODUCTION OF INFORMATION** (ISO 19650 Section 5.6)	**7. INFORMATION MODEL DELIVERY** (ISO 19650 Section 5.7)	**8. PROJECT CLOSE OUT** (End of Delivery phase) (ISO 19650 Section 5.8)
TASKS:								
	Identify project goals and establish client information requirements for the project and assets **BY WHOM:** CLIENT Align project goals and needs with BIM uses **BY WHOM:** CLIENT/PM/ BIM MANAGER Develop project BIM brief **BY WHOM:** CLIENT/PM/ BIM MANAGER	Finalise project BIM brief **BY WHOM:** CLIENT/PM/ BIM MANAGER Establish how you want tenderers to respond to the BIM requirements and the criteria for how they will be evaluated **BY WHOM:** CLIENT/PM/ BIM MANAGER Assemble reference material and any shared resources **BY WHOM:** CLIENT/PM	Assess responses to the Project BIM Brief **BY WHOM:** CLIENT/PM/ BIM MANAGER Review BIM evaluation and responses documents **BY WHOM:** CLIENT/PM/ BIM MANAGER	Confirm that the delivery team's proposal is aligned with the Project BIM brief and MEA (Model element authoring schedule) **BY WHOM:** PM/BIM MANAGER/DELIVERY TEAM	Establish the project Common Data Environment (CDE) **BY WHOM:** PM/BIM MANAGER BIM kick off meeting **BY WHOM:** PM/BIM MANAGER/ DELIVERY TEAM Develop BIM execution plan **BY WHOM:** PM/BIM MANAGER/ DELIVERY TEAM Test the projects information production methods and procedures **BY WHOM:** BIM MANAGER/ DELIVERY TEAM	Confirm BIM execution plan **BY WHOM:** PM/BIM MANAGER/ DELIVERY TEAM Confirm reference information and share resources are available on CDE **BY WHOM:** PM/BIM MANAGER Develop information and project information models **BY WHOM:** DELIVERY TEAM Complete quality assurance and control checks **BY WHOM:** BIM MANAGER/ DELIVERY TEAM Review and approve information/models for sharing **BY WHOM:** BIM MANAGER/ DELIVERY TEAM	Submit information and project information models for approval **BY WHOM:** DELIVERY TEAM Review and approve information align's with BIM execution plan and MEA (Model element authoring schedule) **BY WHOM:** BIM MANAGER Submit information and project information models for approval **BY WHOM:** CLIENT/PM Review and approve information **BY WHOM:** CLIENT/PM Develop a handover report **BY WHOM:** BIM MANAGER	Enable information to feed in asset management system **BY WHOM:** CLIENT Debrief and compile lessons learnt **BY WHOM:** CLIENT/PM/ BIM MANAGER/ DELIVERY TEAM Archive information and project information models **BY WHOM:** CLIENT
OUTPUTS:								
	🗀 **BIM BRIEF** 🗀 **MEA** (Model element authoring schedule)	🗀 **BIM BRIEF** 🗀 **MEA** (Model element authoring schedule) 🗀 **BERT** (BIM evaluation & response template) ASSET INFORMATION REQUIREMENTS	🗀 **BERT** (BIM evaluation & response template)	CONTRACT NZCIC Guidelines PROJECT PROGRAM	🗀 **BIM EXECUTION PLAN** (Draft) 🗀 **MEA** (Model element authoring schedule)	🗀 **BIM EXECUTION PLAN** 🗀 **MEA** (Model element authoring schedule)	HANDOVER REPORT	AM/FM PLAN (Asset Management / Facilities Management Plan)
PROJECT INFORMATION MODELS →							ASSET INFORMATION MODELS →	

Note: This workflow diagram should be read in conjunction with the project execution plan.

Key: 🗀 **See related appendices.**

**INFORMATION FROM ISO 19650-2*

The project BIM brief should contain the following baseline information:

- Project information
- Key project contacts
- Project goals and objectives
- BIM use competency requirements
- Client specific requirements, including the use of a common data environment
- Project deliverables
- Reference documents and standards

The project BIM brief should also identify construction and operation phase BIM uses, and deliverables required by the client, irrespective of services procured. The requirements of later phases may impact on outputs consultants are required to produce.

When consultants respond to the Request For Proposal (RFP) they should complete a BIM evaluation and response template to outline how they will meet specific requirements and deliverables that fall within their scope.

In the case of projects procured on a design and build basis, consultant/contractor responses to the RFP should clearly illustrate who is responsible for each BIM use and the competency of the related party.

5.3 Model element authoring schedule

A Model Element Authoring (MEA) schedule forms part of the BIM briefing and BIM execution planning process. It's main purpose is to determine who is responsible for modelling what, and when, in the project. The schedule assigns responsibilities to model elements via an author and defines the Level of Development (LOD) that applies to model elements aligned to project phases.

Model element ownership transitions between disciplines as design progresses. For example, at the concept design stage the architect may model and own the structural columns, but ownership transfers to the structural engineer from the preliminary design onwards. Critically, at any point in time only one version of the same model element must exist within the building information model.

Find a model element authoring schedule in **Appendix F.**

5.4 BIM evaluation and response template – pre-contract

The BIM evaluation and response template is a supplemental template to the project BIM brief in the RFP stage. The template provides a consistent framework for the BIM component in the response to an RFP. Each tenderer should include a BIM evaluation and response in their RFP to demonstrate their proposed approach, capability, capacity, and competency to meet the project BIM brief requirements, as they relate to their specific discipline and/or project role.

BIM evaluation and response template should request details covering:

- Roles and responsibilities
- Standards, methods, and procedures
- Collaboration procedures
- Model and information QA procedures
- Proposed strategy for project/asset information model delivery, if required

A compliant BIM evaluation and response template demonstrates how the tenderer will meet requirements outlined in the project BIM brief. Accordingly, the project BIM brief provides the basis of information for review in the tenderer's BIM evaluation and response document. Where possible, the BIM evaluation and response document and the BIM brief should cross reference contents to assist evaluation.

Find a BIM evaluation and response template in **Appendix G.**

5.5 Design BIM execution plan

Following the appointment of the successful tenderer, reconcile and further develop the BIM brief to form a comprehensive design BIM execution plan that identifies how BIM will be planned, executed, and managed throughout the design phase of the project.

Work collaboratively with the BIM manager and discipline BIM leads to include their specific requirements in the BEP.

Find a project BIM execution plan template in **Appendix H.**

The design BIM execution plan should include the following baseline information:

- Project information
- Key project contacts
- Project goals
- BIM uses
- Information management and exchange
- Collaboration
- Project deliverables
- Quality control
- Model element authoring schedule
- Reference documents and standards

Reconciliation and further development of the BEP should be a contractual requirement, and completed within an agreed period of the contract being awarded.

The project BIM execution plan is a live document and should be updated when project drivers change. Subject to conditions of contractor procurement, avail the design BIM execution plan to contractor(s) at the earliest opportunity to communicate the intent of the design building information models.

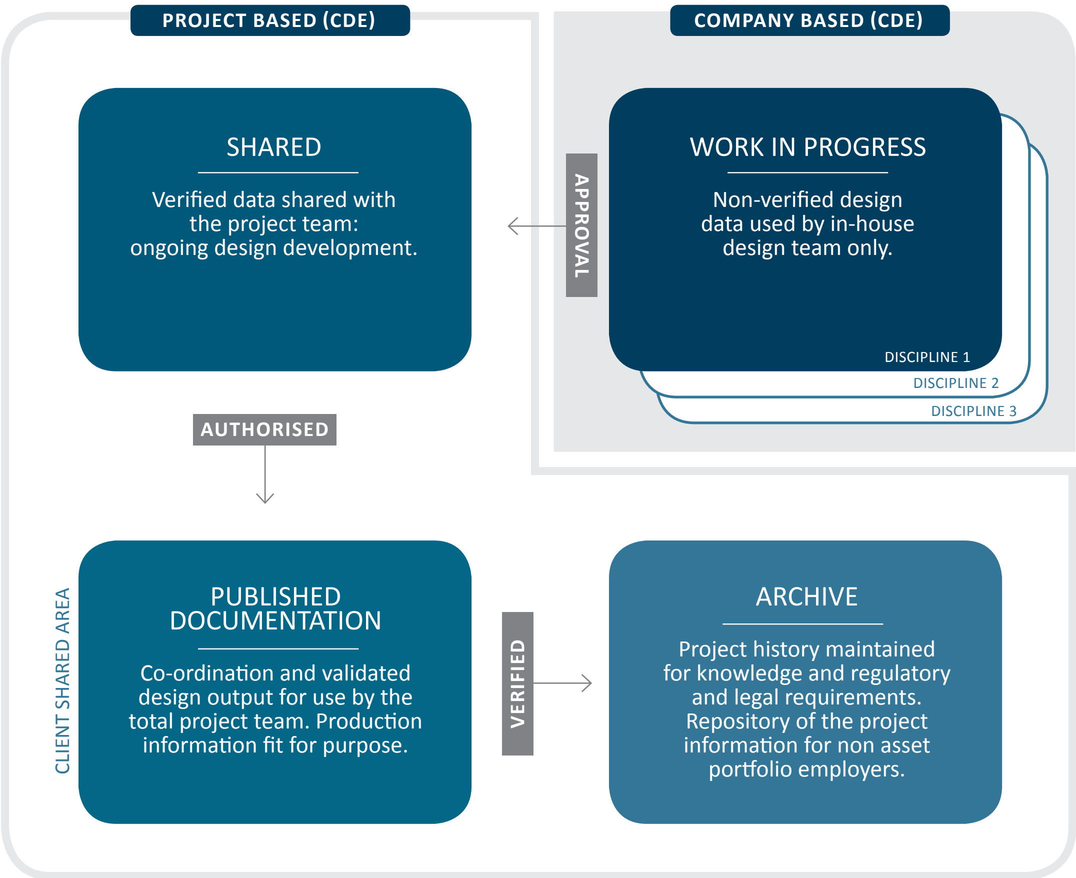
5.6 Common Data Environment (CDE)

The design BIM execution plan specifies the use of a Common Data Environment (CDE) as the means to manage project information. CDE is defined as a single source of information for any given project. It functions as a digital hub for project stakeholders to collect, manage, and disseminate relevant approved project information in a managed environment. Information includes building information models, drawings, reports, and other project-related information.

Subject to conditions of contractor procurement, avail the design BIM execution plan to contractor(s) at the earliest opportunity to communicate the intent of the design building information models.

The CDE manages the flow of information through four distinct phases, as shown in figure 9 below.

FIG 9.
THE COMMON DATA ENVIRONMENT (CDE)



The CDE comprises two main areas – one for company-based information and the other for project-based information.

Company-based CDE is managed on each discipline's network.

- **Work in progress:** Each member of the project team can carry out their own tasks before issuing information to other members of the project team

Project-based (CDE) covers information that is shared, published, and archived

- **Shared:** Information from project team members is stored in the CDE when it is ready to be shared with other team members to support on-going design development
- **Published documentation:** Documentation based on information in the shared location is published at key milestones. This information is reviewed and approved by nominated approvers within each discipline
- **Archive:** Historic versions of information are stored in the archive location and remain available for future reference

When the project is delivered, the project CDE should be archived and formally handed over to the client for project close-off.

5.7 Construction BIM execution plan

The construction BIM execution plan defines how BIM is planned, executed, and managed throughout the construction and handover stage of the project. It should directly address construction and handover-related client BIM requirements, as well as additional BIM uses the contractor intends to implement on the project.

A construction BIM execution plan should be the product of a collaborative effort that includes the specific requirements of each sub-contractor. The plan can be prepared as soon as the contractor has been engaged or, depending on the procurement method, even before they're engaged. The execution plan exists either as a document in its own right that sits alongside the design BIM execution plan, or as an expansion of the design BIM execution plan, forming a combined project BIM execution plan.

Find a construction BIM execution plan in **Appendix H.**

The construction BIM execution plan should contain the following base-line information:

- Project information
- Key project contacts
- Project goals and objectives
- BIM uses
- Information management and exchange
- Collaboration
- Project deliverables
- Quality control
- Model element authoring schedule
- Reference documents and standards
- Handover model and information details

A live document, the construction BIM execution plan should be updated when project drivers change.

5.8 FM/AM plan

The Facilities Management/Asset Management plan (FM/AM plan) lays out the client's strategy for a built asset's ongoing operation. The plan should include the following items:

- Asset information hierarchy
- Asset information requirements
- Asset information strategy
- Preventative maintenance strategy
- As-Built model/documentation requirements

Outputs from the BIM process feed into the FM/AM plan. For example, asset information can be fed into the Computer Aided FM (CAFM) system. Alternatively, the FM/AM plan, including for example asset data and record model requirements, can be fed directly into the project BIM brief. Start with the end in mind.

5.9 Data capture

Creating a complete information model requires both graphical and non-graphical information for existing structures and surrounding ground features. Obtaining this information involves conventional survey techniques and automated scanning equipment. Depending on the scale of the asset and accuracy required, automatic scanning solutions include:

- Simple photo images from 360 degree cameras
- Point cloud data sets from survey quality scanners
- Laser generated maps from ground-based or aerial equipment (LiDAR)

Generating a model of existing conditions can be costly. Like other BIM processes, start with the end in mind, creating a clear brief for the people undertaking data capture. Discuss and agree the following:

- Required accuracy: Includes both graphical accuracy of scanned objects and how accurately they are located and linked to geographic coordinates in all three dimensions
- Area capture: Scan as many details as practical – it may save a rescan when additional features are required for other uses
- Data format: Scanning produces large volumes of raw data. Decide who will translate the data into useful information
- Non-graphical information requirements: Confirm format and agree who is responsible for information capture, and how it will be associated with graphical details

The process of capturing existing features should be included in both the BIM brief and BIM execution plan.

6— Modelling and documentation practice

Find detailed guidance on modelling and documentation best practice in **Appendix A.**

6.1 Planning the modelling process

This handbook recognises that projects are unique, each with different drivers and project owners with specific modelling standards and protocols. Treating projects and companies as the same is both impractical and likely to stifle innovation.

Taking a collaborative approach to developing the BIM execution plan ensures project standards, methods, and processes are aligned.

6.2 Model location and orientation

Place models in real-world coordinates, with north orientation, elevation, and set-out from boundaries. Confirm this approach in the BIM execution plan.

6.3 Naming conventions and structures

Reusing information efficiently throughout the life of the model and the related asset is one of the greatest benefits of BIM. Discuss and agree definitions and naming conventions with the client and other stakeholders as the BIM execution plan is written:

- How spaces are defined and named
- Granularity and naming conventions for elements
- Specific parametric requirements for elements

Information should be structured to align with the end-user's asset information management system – even when the end-use of the model/information hasn't been confirmed. Information must be created in a way that is structured and consistent for future translation.

6.4 Level of Development (LOD)

LOD is a scale used to show the reliability of content likely to be included for specific model elements, at different times, during model development. The main reason to incorporate LODs in model element authoring schedules and BIM execution plans is to make things clear for each member of a design/construction team – so they know what to author in their models at each stage, and to what extent others can rely on their models.

LOD applies to elements within a model – not the overall model. Critically, as the LOD progresses, other information associated with the elements also progresses – not just the geometry.

It is important to get the required LOD for each element confirmed at the completion of the design phase, before the model is transferred to the contractor. This is typically with elements at LOD 300 or LOD 350. The BIMForum LOD specification definitions of LOD 300 and LOD 350:

LOD 300 – The model element is graphically represented within the model as a **specific system,** object, or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the model element.

LOD 350 – The model element is graphically represented within the model as a **specific system,** object, or assembly in terms of quantity, size, shape, location, orientation, **and interfaces with other building systems.** Non-graphic information may also be attached to the model element.

The main body of the BIMForum document provides more detail for each LOD on an element-by-element basis.

The BIM Acceleration Committee considers the body of the BIMForum document provides greater clarity, however has amended the LOD 300 definition for New Zealand practices:

LOD 300 – The model element is graphically represented within the model as a design-specified system, object, or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the model element.

The definition of LOD 350 (and other LODs) remains unchanged.

The modified definition of LOD 300 recognises that for many systems, the type of 'specific system' is selected by specialist vendors and trade contractors – not the designer. Actual requirements should be confirmed on a project-by-project basis and recorded in BEP and MEA tables.

LOD is one of the least understood aspects of the BIM process. LOD specification, produced by the BIMForum **(https://bimforum.org/lod/)**, offers the most complete information on this subject.

Find a more complete overview of LODs in **Appendix C.**

6.5 BIM quantity surveying and cost estimation

BIM is an effective digital tool for quantity surveyors to assess and influence design and delivery processes to provide better commercial outcomes. Quantity surveyors should be involved in the planning of the modeling process. They should define specific modeling requirements to allow compliance with quantity surveying fundamentals. Leveraging information generated within the model allows the quantity surveyor to focus on verification and validation processes.

Find a summary of modelling requirements for quantity surveyors in **Appendix A.** Further information on BIM quantity surveying and cost estimation can be found in AIQS and NZIQS Australia and New Zealand BIM Best Practice Guidelines (2018).

6.6 Model coordination

One of the key benefits of the BIM process is the ability to coordinate modelled elements. Significant savings can be made on site by resolving coordination issues in the modelled environment.

Discipline BIM leads are responsible for ensuring their models are coordinated, both within themselves and with the other disciplines. Resolve major coordination issues before models are federated. Run through clash detection programmes. Find additional information on model coordination in **Appendix I.**

6.7 Model handovers

When a model is issued, the discipline BIM lead should include a Model Description Document (MDD) to share crucial information about the model with other users, describing its contents and explaining purpose and limitations.

When the format and content of the MDD has been agreed, it should be documented as part of developing the BIM execution plan. Find an example of a completed MDD in **Appendix Ji.**

6.8 BIM deliverables

The project BIM brief should clearly outline deliverables. Today, most contracts are 2D paper documents (drawings, schedules, and specifications), but as the industry matures, models will become contractual deliverables as well. This information should be included in the BIM brief and BIM execution plan.

When the model has an agreed handover requirement – either from the design team to the contractor, or from the contractor to the client/operator – you need to confirm the following:

- Separate or combined models
- Format/file type
- Model inclusions – what's in and what's out

2D deliverables generated from the model should accurately represent the view of the model. Do not modify models in their 2D format.

7— BIM in New Zealand construction

Contractors in New Zealand's building and construction sector are looking for opportunities to streamline processes, drive out risk, and reduce errors.

BIM delivers wide-ranging benefits to construction phases of a project, including:

- Reduced on-site waste and rework thanks to improved coordination
- Opportunities for offsite manufacture and prefabrication
- Improved health and safety from better planning
- Tighter scheduling and cost management linked to construction BIMs
- Opportunities for buildability and construction methodology reviews
- Improved construction sequence planning
- More accurate construction programming from testing/optimising construction sequences

Ideally, contractors will leverage models produced by design consultants. However, for contractors to take this opportunity, designers need to know expected construction phase BIM uses via the BIM brief. Consider the following factors as construction requirements are pushed back into design:

- Modelling to a construction level takes more time – and cost. Investigating multiple options at this level of detail is not always efficient
- Construction level detailing may be product-specific, in which case competitive supply differentials between contractors no longer apply
- Contractor-preferred construction methodologies may differ

Project procurement must evolve to maximise the benefits of BIM. Overseas evidence shows the greatest scope for overall modelling efficiency comes from integrated project delivery (IPD), early contractor involvement (ECI), and design and build.

As industry capability improves to consistently realise these gains, consider the following actions to capture immediate improvements:

- Ensure clients include expected construction phase BIM uses in the project BIM brief
- Once BIM uses have been defined, provide a clear scope of deliverable requirements
- Ensure designers understand the time and financial impacts of incorporating BIM uses to allow for value judgments
- Ensure design models clearly identify what they can – and can't – be used for; and how they align with the contracted requirements in the project BIM brief
- Confirm contractors understand the time and financial benefits of working with more detail, and how they can pass these savings on to the client
- Align procurement methodologies and programmes with the BIM process
- Conduct regular information audits to confirm requests have been included in BIM
- Ensure appropriate value has been assigned to the As-Built/handover BIM

8— BIM and horizontal infrastructure

Road, rail, water and similar infrastructure networks are critical to our social and economic wellbeing. These networks are enhanced or extended through capital construction projects. They also need to be operated, maintained, and renewed. BIM has the potential to enhance traditional asset management information systems through the asset life cycle, at both a network and individual component level.

NETWORK MANAGEMENT CONTEXT

Infrastructure networks are managed as an integrated whole. Clients typically adopt consistent data and information standards and processes across their networks. Information requirements encompass inputs for life cycle asset management, including infrastructure and network description, improvement renewal and maintenance works, infrastructure condition, service performance, demand, and relevant contextual information.

System/network usage and capacity are key pieces of information for successfully operating horizontal infrastructure assets. This information encompasses forecasts and measured or derived values, information source and reliability, risk management and uncertainty, and social and financial dimensions.

The information requirements for a network are extensive, with each activity, such as a capital improvement project or repair work, using the relevant subset of the full information requirements.

Works projects or programmes generate new information that must be added to the client's information system. Applying a consistent definition to asset identification, description, and segmentation of new infrastructure attached to the existing network ensures As-Built information is added and managed alongside the existing infrastructure.

A common form of segmenting linear infrastructure, such has roads, hasn't yet been developed, neither has a consistent approach to geometry used natively across the common BIM, GIS, or asset management information tools.

HORIZONTAL INFORMATION REQUIREMENTS

Initiatives to harmonise information requirements for similar infrastructure networks aim to improve the efficiency of asset life cycle management, and assist the fluent sharing of data between adjacent linked networks. These will likely lead to the adoption of standard information requirements for different classes, potentially replacing the current requirements of network managers.

Current New Zealand initiatives are addressing this issue for transport and water infrastructure.

9— Enabling asset management

The operational phase of a built asset accounts for the greatest overall cost and, therefore, stands to reap significant benefits from BIM.

Facilities Management (FM) and Asset Management (AM) information has traditionally been sourced manually from As-Built drawings and manuals, work records, and condition and performance surveys contained in a range of locations, including standalone Asset Management Systems (AMS), Computer Aided FM (CAFM) systems, spreadsheets, and hard copy schedules.

BIM can be used throughout the delivery of a construction project to centrally collate, store, and publish asset information to make it available to owners and operators as the physical assets are handed over.

Engage the FM/AM team at the start of the project to confirm their needs. Focusing on information related to maintaining facilities will deliver the greatest benefit for ongoing FM/AM.

9.1 Modelling best practice

Information must be modelled consistently to be transferred correctly from the BIM into other systems. Appendix A covers information on modelling best practice. Individual managed assets in the model require a unique and static identifier to act as a key value to link to other systems. This can impact the granularity, level of detail, and structure of elements within the model. For example, if the AMS system requires separate lists for door structure and door hardware, these items must be input as separate elements within the model.

9.2 Building owners and FM use

A well-structured BIM process can provide the building owner/operator with the following benefits:

- The opportunity to review BIM models at each design and construction stage to confirm the facility's maintainability
- A faster way to populate AMS and CAFM systems with asset data exported from an As-Built BIM model
- Link operating and maintenance (O&M) manuals to specific components in the As-Built BIM
- More transparent commissioning processes, by linking final commissioning results to an As-Built BIM for easy future retrieval
- Facilitate smoother building completion when using BIM in conjunction with contracted frameworks, such as CIBSE soft landings
- Enable FM to assess future building amendments using an As-Built BIM
- Use the final BIM for space management. Note: rooms must be modelled as 'spaces' with clearly defined boundaries
- Improve building operating efficiency by using BIM for energy analysis

9.3 Applying BIM to AM – challenges

While there are clear opportunities to increase the use of BIM in the operational stages of a facility, a number of historical barriers to implementation remain in the way.

CLIENT BIM UNDERSTANDING AND DIRECTION

For the supply chain to deliver the correct information in the correct format there must be a clear understanding from the client about how and when this information will be used, and the expected level of interoperability with other systems.

More sophisticated AM uses of BIM, such as energy analysis, space management, and scheduling maintenance activities, require compatible systems. First, gauge compatibility and investigate integration options, which may involve internal client process changes. Keep in mind that client BIM requirements should be realistic for existing or planned AM structure, and accurately specified in the project BIM brief.

LEGACY CAFM SYSTEMS

Many organisations continue to use technology for day-to-day asset management that pre-dates BIM technology. As BIM does not replace an AIM or CAFM system, these systems must be integrated.

There are a number of ways to integrate BIM with asset management:

- Populate an asset register (CAFM, AMS, or spreadsheet) via the one-way export of data from the building information model(s)
- Use a central database, or middleware, to link various asset-centric systems and databases with building information models. This will provide a 'single source of truth' for asset data, with mono or bi-directional workflows supporting defined information use cases
- Early in the project determine if your asset management system is interoperable with building information models (and/or other databases)

9.4 The move from passive to active BIM

To gain the most from BIM use, internal client stakeholders must participate in a process to establish their BIM requirements. The process drives a shift from a passive BIM client to more active BIM involvement.

The supply chain must use the correct naming conventions and units of measure when populating data in the model. Check existing client standards and/or systems, or existing industry standards, such as the NZ Metadata Standards.

Involving asset managers in the development of a BIM brief provides the opportunity to close the life cycle loop and apply lessons learned from operating facilities. However, taking this opportunity requires an accurate assessment of the operational needs of data requirements for asset management. As such, all internal business stakeholders should accurately state their needs. By taking the lead in producing a BIM brief that considers wider business strategies, clients are in a stronger position to drive their digital journey to meet the future needs of the business.

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9.5 Recommended approach

Identify AM requirements when the project BIM brief is prepared and handed to designers for inclusion in the BEP. Designers and constructors should prepare the BIM so that information can be extracted at a later date and, if necessary, reformatted to align with the selected CAFM system. The information can be translated from one schema to another, provided it is well structured and consistent.

All BIM contributors, such as vendors, subcontractors, and commissioning agents, must be made aware of their information content and structure requirements. Include BIM information audits in quality assurance processes, during both design and construction phases, to ensure the optimum result at handover to the owner/operator. Either the BIM manager or a separately engaged information manager should manage this task.

Glossary

Terms used in this handbook and in discussions about BIM:

4D BIM – A 3D model linked to time or scheduling information. Model objects and elements with this information attached can be used for construction scheduling analysis and management. 4D BIM can also be used to create animations of project construction processes.

5D BIM – A 3D model linked to cost information. The time information adds another dimension to cost information, allowing expenditure to be mapped against the project programme for cash flow analysis, etc.

Appointed party – From ISO 19650. The organisations that are engaged by the client (appointing party) to design and construct the project. A lead appointed party may be assigned during the design phase (lead consultant) or during construction (main contractor).

Appointing party – From ISO 19650. The client or employer. The organisation that is commissioning the project or owns the asset.

Asset – Completed building, facility, or infrastructure

Asset Information Model (AIM) – A maintained information model used to manage, maintain, and operate the asset. May contain documentation, non-graphical information, and graphical model.

Asset Information Requirements (AIR) – Specification for information and attributes for items the client has deemed necessary to operate and maintain the asset.

Asset life cycle – The complete life of an asset from feasibility and planning through design, construction, and operation, to eventual disposal or repurposing.

Asset Management (AM) – The process of managing the financial aspects of assets, including buildings, properties and infrastructure, and issues such as initial value, depreciated value, and future commitments.

Asset Management System (AMS) – Technology that supports the management of an organization's assets.

Attribute – Graphical and non-graphical details relating to an object

Augmented reality – Technology that superimposes a computer-generated image or information on a user’s view of the real world, providing a composite view.

BIM evaluation and response template – A supplementary document to the project BIM brief in the RFP, or contractor procurement stage, that aims to provide a consistent framework for the BIM component of an RFP.

BIM Execution Plan (BEP) – A formal document that defines how a project will be executed, monitored, and controlled with regard to BIM. A BEP is developed at project initiation to provide a master information management plan, and specifies roles and responsibilities for model creation and information integration throughout the project.

BIM information manager – Same as BIM manager.

Building information management (data definition) – Building information management supports the information standards and information requirements for BIM use.
Data continuity promotes the reliable exchange of information in a context where both sender and receiver understand the information.

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 life cycle from inception onward.

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 information generated from the model.

BIM management plan (BMP) – Same as BEP.

BIM manager – Leads and coordinates the BIM processes for the project.

BIM use – A unique project task or procedure that benefits from the application and integration of BIM into that process, e.g design authoring, 3D coordination (refer Appendix D)

Computer Aided Facilities Management (CAFM) – An IT system that supports facilities management. CAFM systems focus on space management issues, asset information, maintenance history, and equipment documentation.

CBI – Coordinated Building Information system of New Zealand. The classification system is used to organise specifications, structure information libraries, classify generic and branded product information, and classify BIM objects.

Collaboration – Multiple parties working in a way that is focussed on a common outcome rather than individual goals.

Common Data Environment (CDE) – A single source of information for any given project. CDE functions as a digital hub from which project stakeholders can collect, manage, and disseminate relevant approved project information in a managed environment.

Construction BIM execution plan – A BIM execution plan for the construction phase of a project.

Construction Operations Building information exchange (COBie) – A system for capturing information during the design and construction of projects. Used for facilities management purposes, including operation and maintenance. A key element of the system is a pre-formatted Excel spreadsheet for recording this information.

Coordination – The process of ensuring the correct spatial separation of elements within a model or on site.

Deliverables – The product of engineering and design efforts, delivered to the client as digital files and/or printed documents. A deliverable may have multiple phases.

Design and Build (D&B) – The project procurement method in which the client enters into one contract for the design and construction of a project with an organisation, generally based on a building company providing all project management, design, construction, and project delivery services.

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. Documents are used for bidding (tendering). The successful bidder, generally a building company, enters into a contract with the client to build the project.

Design BIM execution plan – A BIM execution plan for the design phase of a project.

Design BIM lead – The BIM lead for each design discipline or sub-trade.

Early Contractor Involvement (ECI) –The project procurement method where a contractor is engaged during the design phase (with no assurance of continuing to provide physical construction services) to provide buildability, programming, and systems selection advice.

Facilities Management (FM) – The process of managing and maintaining the efficient operation of facilities, including buildings, properties, and infrastructure. The term also applies to the discipline concerned with this process.

Federation/federated model – The combination of multiple models into a single model for review or coordination.

gbXML – Green building extensible markup language (XML). A digital file format for exchanging sustainability information in simulation applications.

Generative design – Automatically creating alternative model solutions based on ranges of inputs and output goals.

Geographic Information System (GIS) – A system that integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information.

Globally Unique Identifier (GUID) – A unique code identifying each object/space. A GUID should not be confused with code – as in room code, equipment code, or space code. The GUID assigned by the BIM authoring tool persists through room name changes and various other modifications, allowing the object/space to be tracked throughout the project execution process.

Horizontal infrastructure – Network assets, including road, rail, water, power, and communications distribution systems

Industry Foundation Class (IFC) – A system for defining and representing standard architectural and construction-related graphic and non-graphic information as 3D virtual objects. Promotes information exchange among BIM tools, cost estimation systems, and other construction-related applications in a way that preserves the ability to analyse those objects as they move from one BIM system to another.

Integrated Project Delivery (IPD) – 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. Characterised by an expectation that the team will work collaboratively to deliver a product that meets client requirements.

Intellectual Property (IP) – The legal term relating to the ownership of specific design elements, tools, and processes. IP ownership should be defined in the contracts with designers.

Interoperability – The ability of two or more functional units to exchange information and use it readily. Exchange should not require users to possess knowledge of the unique characteristics of those units.

Level of Development (LOD) – A scale used to describe the level of completeness to which a model element can be relied on at different times during model development.

Metadata – Commonly defined as data about data, though differing from the data itself. For example, in a BIM context, object size = 300mm – object size is metadata, 300mm is data.

Model Description Document (MDD) – A document issued with a model to describe what it contains and any limitations of use.

Model Element Author (MEA) – Ensures the model develops and is coordinated according to project requirements.

Model Element Authoring schedule (MEA) – Assigns responsibilities to model elements via an author. Defines the LOD of model elements aligned to project phases.

Model/information model – A model comprising documentation, non-graphical information, and graphical information

Model manager – Same as discipline BIM lead.

Model View Definition (MVD) – MVD defines a subset of the IFC schema, providing implementation guidance for all IFC concepts (classes, attributes, relationships, property sets, quantity definitions, etc.) used within this subset. It represents the software requirement specification for the implementation of an IFC interface to satisfy the exchange requirements.

Non-graphical Information – Information, such as operating manuals, performance limits, and supplier details, that can be attached to a graphical object within a model.

Object – A modelled item within and asset.

OmniClass – A classification system for the construction industry, developed by the Construction Standards Institute (CSI), and used as a classification structure for electronic databases.

Project – The process of creating or modifying an asset.

Project BIM brief – A document developed by a client to outline their BIM requirements when engaging designers or design and build teams.

Project information model – The information model relating to the design and construction delivery phase. May contain the information model, contracts, reports, certificates, and communications data set.

Project objectives – Overarching outcomes that the client aims to achieve from the project, e.g. improved operating efficiency, stakeholder satisfaction, reduced journey times.

Request for Information (RFI) – A documented request for information on a matter from one party to another. Typically managed through formal procedures agreed by members of the project team.

Record modelling – The creation of a digital record of the as-constructed graphical and non-graphical information relating to an asset.

Uniformat – A classification system for building elements, including designed elements, that forms the basis of Table 21 of the OmniClass system. A product of the Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC).

Virtual reality – An immersive 3D environment, isolated from the real world, where graphical and non-graphical information can be viewed and manipulated.

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