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THE NEW ZEALAND BIM HANDBOOK

A Guide to Enabling Building Information Modelling (BIM) for the Built Environment - 2023 Fourth Edition

CONSTRUCTION SECTOR ACCORD

BIM BETTER BUILDING PROCESS. BUILDING BETTER PERFORMANCE.

New Zealand Institute of Building

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The BIM in NZ Steering Group thanks these organisations for granting the use of text and graphics from their documents in this handbook. Copyright in ISO 19650.2:2018 is owned by the International Organization for Standardization (ISO) and administered by the New Zealand Standards Executive.

ISO 19650 1-2 can be obtained in PDF or hard copy formats from: https://www.iso.org/store.html or https://shop.standards.govt.nz/catalog/ics/.

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FOREWORD

Few advancements hold as much promise for improving the performance of New Zealand's construction, and asset operation sectors as Building Information Modeling (BIM). Surveys conducted by EBOSS and other anecdotal evidence indicate a healthy uptake and understanding of BIM in the country. Industry training and increasingly knowledgeable clients are driving its adoption further. Digitization is occurring across the supply chain. Digital Strategies for process transformation are crucial to get agreement on.

Digital and innovation competency is a must in tackling the challenges faced by the construction industry. The ability to adapt to emerging technologies and foster innovation-driven solutions is key to driving transformation within this sector.

We are excited to get behind all the talented experts involved with BIMinNZ, and The New Zealand Institute of Building in updating the NZ BIM Handbook.

The first edition of this handbook was released in July 2014, following an industry workshop initiated by the Productivity Partnership. This workshop brought together 50 representatives from across the construction industry. Continuing this tradition of being developed as collaboration with industry at every step.

The approach has been:

- Incorporate best BIM practices worldwide including ISO19650
- Documenting a consistent approach
- Adopting a common language

The aim of this handbook, forming part of the Digital Guidance Suite, remains the same: to harness the numerous benefits of BIM, facilitate its usage, and promote the creation, maintenance, and operation of high-quality built assets in New Zealand.

The Digital Guidance Suite includes:

- Value Case for Digital First – The WHY and evidence to support decision makers
- NZ BIM Handbook – delivers detailed guidance on "HOW" to conduct digital activities (with supplements added over time such as contract conditions)

With this latest edition of the Digital Guidance Suite including the NZ BIM Handbook, we continue our mission to drive productivity into the sector. A special thanks to everyone involved.

Jane Henley
Transformation Lead - Innovation
Construction Sector Accord

1— INTRODUCTION

1.1 BIM DEFINED

BIM (Building Information Modeling) definitions vary across designers, constructors and operators. The BIM in New Zealand (BIMinNZ) Steering Committee offers the following definition:

> **BIM IS A COLLABORATIVE 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, operations, 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, software or a computer-based fabrication. BIM is being aware of the information needs of others as you go about your work.

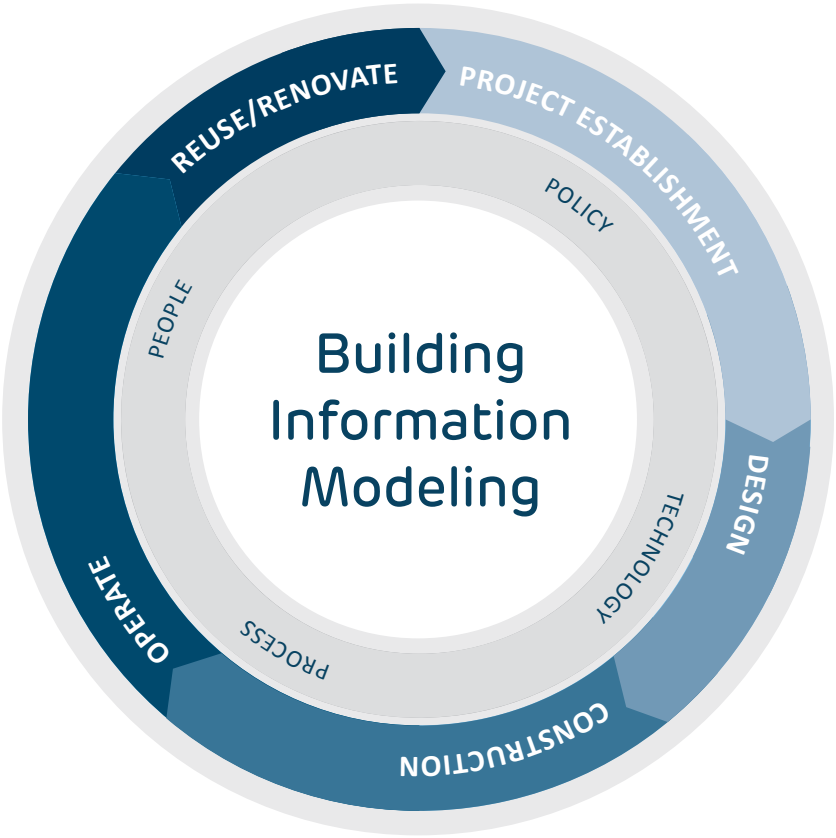


Fig 1 – The Project Lifecycle

1.2 PURPOSE OF THIS HANDBOOK

This handbook, created by the BIMinNZ Steering 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 and 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.

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 has evolved in its maturity and application of BIM processes, along with the growth in understanding and adoption within the industry.

In this edition, the authors have further aligned terminology and processes with ISO 19650, to increase the likelihood of information being provided to the right person at the right time.

1.3 BENEFIT OF ADOPTING BIM PROCESSES

BIM supports the project life cycle's feasibility, planning, design, construction, operation and reuse/ renovation stages. Approaching these processes as a whole supports more coordinated information sharing that enhances the overall benefits of BIM.

The value of BIM adoption is widely documented internationally, but not always understood and rarely benchmarked or measured. A framework for the selection of tangible and intangible benefits of BIM to the New Zealand construction sector, how they relate to time, cost and quality, and which stages of the project and asset life cycle are affected is shown in the table below.

Fig 2 – BIM Benefits to New Zealand Construction Sector Framework

VALUE	DESIGN & ENGINEERING	CONSTRUCTION & PROCUREMENT	ASSET MANAGEMENT	OPERATIONS	INFORMATION MANAGEMENT	SAFETY IN DESIGN	REPUTATION & ENGAGEMENT	TANGIBLE VALUE	INTANGIBLE VALUE	TIME VALUE	COST VALUE	QUANTITY VALUE	COMMENTS
Improved collective understanding of design intent using 3D and/or immersive visualisations	•	•	•	•		•	•		•			•	The model can be used to better understand and evaluate design concepts and briefing requirements that carry through the whole life of a built asset.
Enhanced engagement with project stakeholders using 3D and/ or immersive visualisations	•	•	•	•		•	•		•			•	Not everybody can read a technical drawing, so more effective means of visual communication provide an easy way to add value to the delivery of a project.
Enhanced 'what if' scenario planning through using the 3D model to support the planning process	•		•	•		•			•	•		•	An accurate record model of existing assets can be used to support the planning of future works, or planning future uses of those assets, providing far greater context than traditional 2D records.
Optimised maintenance and/or clearance zone checking through setting rules within the 3D models to allow automated checking of clearance zones for maintenance	•	•	•	•		•	•		•			•	This supports the safe access to, and efficient maintenance of, maintainable assets.
Improved budget control through virtual model-based quantity take-off	•	•			•		•		•		•	•	Provision of the 3D model as part of the construction tender allows the contractor to interrogate and better understand the design intent and better plan construction methodology
Reduced construction tender risks through the provision of 3D models during the tender process	•	•			•	•		•			•	•	Provision of the 3D model as part of the construction tender allows the contractor to interrogate and better understand the design intent and better plan construction methodology
Reduced design and construction risks through improvements in spatial coordination earlier in the design process	•	•							•	•		•	Early spatial coordination supports a reduction in design changes and RFIs.
Early identification and mitigation of potential changes during construction through using the 3D model to identify issues before they arise on site	•	•						•		•	•	•	The 3D model can be used to automate design coordination which can reduce unknowns such as RFIs and variations. Benchmark RFI and variation count and cost vs historical data for a tangible measure.
Improved construction method statements through using 4D simulation and/or still images of the model to aid communication		•				•	•		•	•		•	This supports clear communication of the proposed construction method and mitigates the risk of misinterpretation.
Improved construction logistics planning through using the model to map crane operations, material handling, equipment movements etc		•				•	•		•	•		•	This allows a better understanding of activities being carried out in parallel, reducing the risk of interference to construction work and other on-site activities.

VALUE	DESIGN & ENGINEERING	CONSTRUCTION & PROCUREMENT	ASSET MANAGEMENT	OPERATIONS	INFORMATION MANAGEMENT	SAFETY IN DESIGN	REPUTATION & ENGAGEMENT	TANGIBLE VALUE	INTANGIBLE VALUE	TIME VALUE	COST VALUE	QUANTITY VALUE	COMMENTS
Reduced construction time and installation risk through implementing a digital site set-out process	•	•	•			•		•		•	•	•	Digital site set-out can also improve the efficiency of the As-building process as what is constructed on site is derived directly from the 3D model.
Optimised data transfer into Asset Information Management Systems through clearly defining information requirements and implementing a robust information management process			•	•	•			•		•	•	•	This allows operations and maintenance teams to have timely access to accurate asset information, thereby allowing for better decision-making and forecasting. Benchmark time taken to populate asset database vs historical data for a tangible measure.
Improved asset management through greater certainty, transparency and availability of graphical and non-graphical asset data			•	•				•		•	•		Making sure that the right people have access to the right information at the right time will streamline the asset-management process. Benchmark time taken to close work orders, average cost of work orders vs historical data for a tangible measure.

1.4 BIM IN NEW ZEALAND

The benefits of improved coordination, reduced rework on site and assisted digital handover of As-Built information to asset owners through designing and documenting in a collaborative digital environment, are now being realised by design and construction teams working on projects of all scales and complexity.

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 be conscious of this when selecting design and construction teams. Following processes for preparing Exchange Information Requirements (EIR) and reviewing the BIM evaluation and response template will help ensure the delivery team's capabilities meet client and project needs.

Today, more projects than ever before require a contractor to maintain BIM throughout the construction phase and provide an As-built or record model, including asset data, at handover and key milestones throughout construction. Maintaining a model during the construction phase can be undertaken by the contractor, a specialist third party sub-contracted to the main 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 and construction teams
- Provide a common framework for designers and constructors to respond to BIM procurement requests
- Create a common language so that clients, designers and constructors understand what they are being asked to provide
- Outline processes to efficiently implement BIM on a project, for all phases
- Provide processes leading to more effective design outcomes
- Offer a framework for people new to BIM to help them understand what is involved and how they will benefit

1.5 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 suite of international standards, the VDAS documents from Australia and Penn State BIM execution-planning documents from the US. Where possible, the handbook uses internationally accepted language and workflows. 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 BIMinNZ Steering Committee and assisting government clients to adopt BIM, the government is committed to supporting the development and uptake of BIM in New Zealand.

1.6 ISO 19650

The ISO 19650 suite of standards provides standardised business proves and definitions for the management of information across an asset's life cycle using BIM.

Many countries, such as the United Kingdom, Australia, Singapore and Norway, have embraced ISO 19650 as a framework for establishing consistent information-management practices in construction and infrastructure projects. It helps organisations to streamline communication, collaboration and data sharing between project stakeholders. The adoption of ISO 19650 in New Zealand has gained momentum in recent years, with some consultant organisations and clients recognising the importance of standardised processes and information management and incorporating ISO 19650 principles into their businesses.

The suite of standards are:

ISO 19650-1 provides a framework for managing information effectively throughout the asset life cycle. It covers topics such as key information management activities, organisational roles and responsibilities and the use of information in decision-making.

ISO 19650-2 provides more specific guidance on the management and collaborative production of information during the procurement and delivery phases of an asset. It covers topics such as BIM execution planning, project information requirements and the exchange of information between parties.

ISO 19650-3 defines the business processes for the management and collaborative production of information for use during the operational phase of assets. Additional guidance is also provided to asset owners in the form of examples of organisational information requirements (OIRs), and information required within an asset information model.

ISO 19650-4 provides recommended concepts and principles for those providing and receiving information. It offers insights into the exchange of information throughout the life cycle of an asset.

ISO 19650-5 provides a framework to assist organisations in adopting a security-minded approach to the management of information relating to sensitive assets.

ISO 19650-6 is currently under development and will provide a framework for the use of BIM for the purpose of health and safety. In New Zealand, guidance is being created by BIMSafe on the implementation of BIM for health and safety.

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

1.7 BIM AND THE NZCIC DESIGN DOCUMENTATION GUIDELINES

This handbook incorporates elements of the New Zealand Construction Industry Council's (NZCIC's) 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 November 2023 version of NZCIC's design documentation guidelines includes 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.

1.8 BIM AND PROCUREMENT

The application of BIM processes in accordance with ISO 19650 is not limited by or to a specific procurement method. The processes can be used in the full spectrum of contracts, from build only, with or without early contractor involvement, to design and build, public private partnerships (PPPs) and alliances.

Due to the collaborative nature of various contract types, some contract types favour BIM, including early contractor involvement, PPP, Target Cost (refer to NZS 3910) and alliancing. For any procurement method, we should map and align:

- The expected milestones of the project
- An appropriate planning process
- BIM workflows
- The 'hold' and 'key decision' points associated with the expected contracting method
- Stage deliverables

The information requirements are key parts of the procurement model. More information on these is provided in the assessment and need and invitation to tender sections of the BIM process section.

The responsibility for this mapping and alignment exercise will vary but will typically be one or multiples of the client and client advisors, the project manager, the lead consultant, the BIM manager or the BIM advisor.

Refer to Appendix E for detailed information on how BIM may be applied across different procurement options.

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 several processes and tasks, such as design authoring and 3D coordination. This handbook categorises these tasks as BIM uses, in the process creating a common language. The BIM handbook contains 21 separate uses, sourced from the Penn State BIM Execution Planning Guide, although 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.

The selection, or application, of BIM uses for a project is seen as a complementary activity to applying the ISO 19650 Information Management processes; the latter provides a structured approach to identifying, creating and managing the information requirements to meet a BIM use on a project.

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.

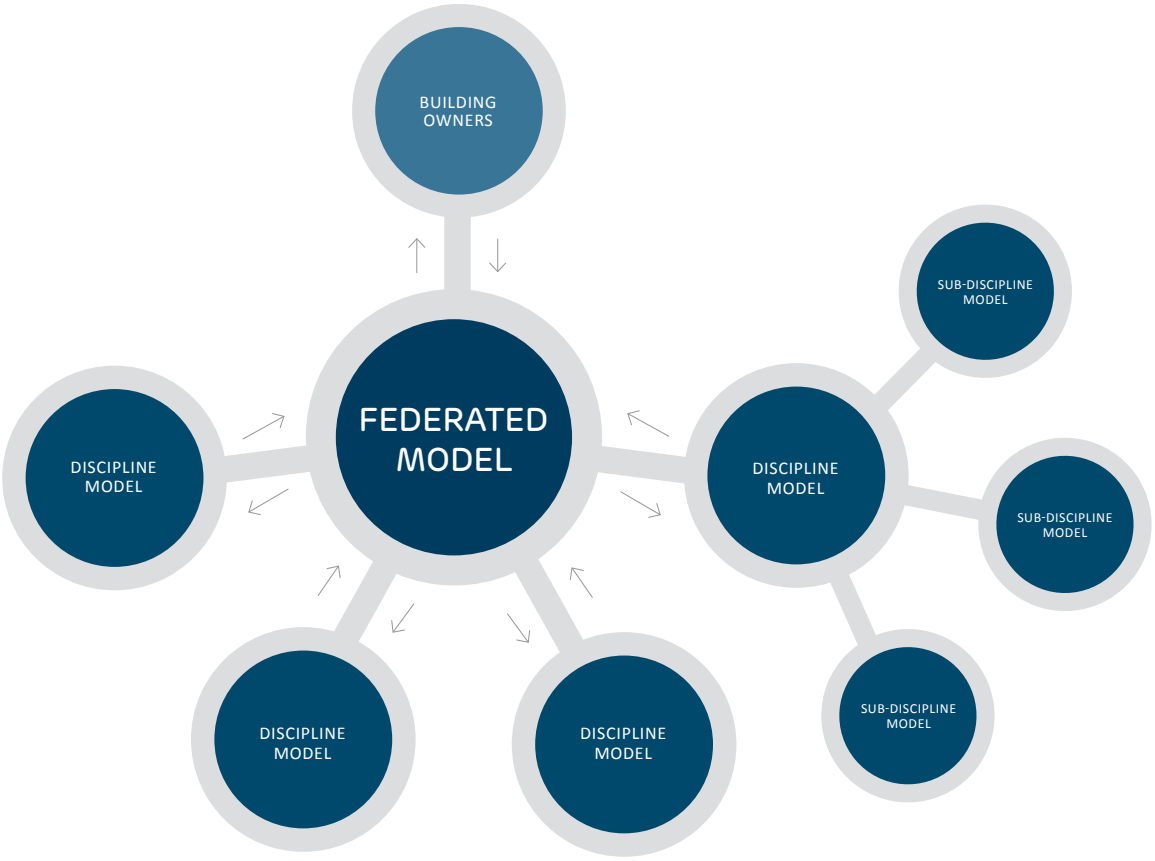
However, when creating a federated model, the information exchange and file format compatibility and interoperability should be documented in the BIM execution plan.

This will ensure that geometry and/or information is managed in compatible file formats to support file sharing between project members and, in the process, a smooth workflow.

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.

The diagram below is an example of how models can be bought together in a federated environment. Disciplines have been excluded from the diagram as these may differ across project typologies.

Fig 3 – Model Federation Diagram



The table below lists possible Discipline or Sub-Discipline models that could be incorporated into a federated model for different project typologies. This list is not exhaustive and should be used as reference only.

BUILDINGS (DESIGN)	BUILDINGS (CONSTRUCTION)	TRANSPORT INFRASTRUCTURE	UTILITIES INFRASTRUCTURE
Architecture	Structural Steel	Urban Design/ Landscape Architecture	Mechanical and Process Plant
Building Services (individual disciplines or combined i.e. MEPF)			
Structure	Precast Concrete	Street Lighting	HV Power
Civil		Track Design	
Geotechnical		Signaling	
Electrical		Traction and Electrical	
Landscape Architecture			

BIM DOCUMENTS

EIR – Exchange Information Requirements

Developed by the client or the client BIM advisor before the project team is engaged, the EIR is a subset of project requirements or equivalent contract documentation. The EIR 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 EIR is derived from the following:

- Organisational information requirements (OIRs): the information needed within the Information Models to enable the organisation to do what it needs to do, both now and in the future
- Asset Information Requirements (AIR): the information needed, within the asset information model, to operate and maintain the asset
- Project Information Requirements (PIR): the information needed to make informed decisions at key decision points throughout the delivery phase
- The EIR should include enough detail to enable the project team to adequately assess the commercial and programme implications of a client's BIM requirements. These requirements should be included in the project contract and implemented through a BIM execution plan

Refer Appendix F.

BIM evaluation and response template

The BIM evaluation and response document is a supplemental template to the EIR in the Request for Proposal (RFP) or contractor procurement stage. It is designed to provide a consistent framework for the BIM component of a response to an RFP, demonstrating how the potential project team member will meet capability and competency requirements in accordance with the EIR. Scored by tender evaluators, the template is pivotal to the selection of the project team.

Refer Appendix H.

Project BIM execution plan

The key document for successfully executing BIM, the BIM Execution Plan responds to the requirements set out in the EIR. Developed by the project team prior to commencing design, the execution plan is a live document updated throughout the 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, requirements, 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 and what is expected by the client.

Refer Appendix J.

2.2 BIM ROLES AND FUNCTIONS

The RACI Matrix below describes BIM roles and responsibilities in detail, but is provided as a guide only as the tasks for a project may be varied depending on the project scale, complexity and contractual arrangement.

Fig 4 – RACI Matrix: BIM Roles and Responsibilities

FUNCTIONS	ACTIVITIES & DELIVERABLES	CLIENT	CLIENT BIM ADVISOR (Where applicable)	BIM MANAGER (Design/Construction)	DISCIPLINE BIM LEAD	MODEL ELEMENT AUTHOR
Project Information Management	Develop the EIR and the end uses of information	A/R	R	C	I	I
	Specify the Organisation Information Requirements and AIR	A/R	R	C	I	I
	Confirm Asset Information deliverables	A	R	C	C	I
	Confirm GIS deliverables	A	R	C	I	I
	Confirm information standards and procedures	A	R	C	C	I
	Set the requirements for the Common Data Environment CDE	A	R	R/C	C	I
	Set the requirements for project deliverables	A	R	R/C	C	I
	Lead BIM delivery on the project	C	A	R	R/C	R/C
BIM Management, Coordination	Lead the development and updates of the Project-Specific BIM Execution Plan	A/R	R	C	I	I
	Develop Information for procurement activities	A/R	R	C	I	I
	Facilitating the use of the project BIM Execution Plan	A	R	C	C	I
	Setup of Survey Control Model	A	R	C	I	I
	Coordination of federated models	A	R	C	C	I
	Lead model auditing and clash management process through design and construction	A	R	R/C	C	I
	Manage the coordination of as built/record modeling through handover	A	R	R/C	C	I
	Set up and manage the ongoing use of issue tracking tools in the BIM environment	C	A	R	R/C	R/C
Model Development and Design Management	Developing model files in accordance with the project BIM Execution Plan	I	C	C	A	R
	Modeling elements at the appropriate Level of Development as defined in the Project BIM Execution Plan	I	I	I	A	R
	Developing and validating as-built record model files in accordance with the project BIM Execution Plan	I	C	C	A	R
	Validating Levels of Model Development at each project design stage	I	C	C	A	R
	Communicating issues to Model Element Authors and leading issue resolution	I	I	A/R	C	C
	Implementing discipline-specific coordination and clash detection procedures	I	I	I	A	R
	Model transfer and version control	I	C/R	A	R	R

KEY	R - Responsible for doing the activity	A - Accountable for activity completion	C - Consulted during activity	I - Informed following activity completion

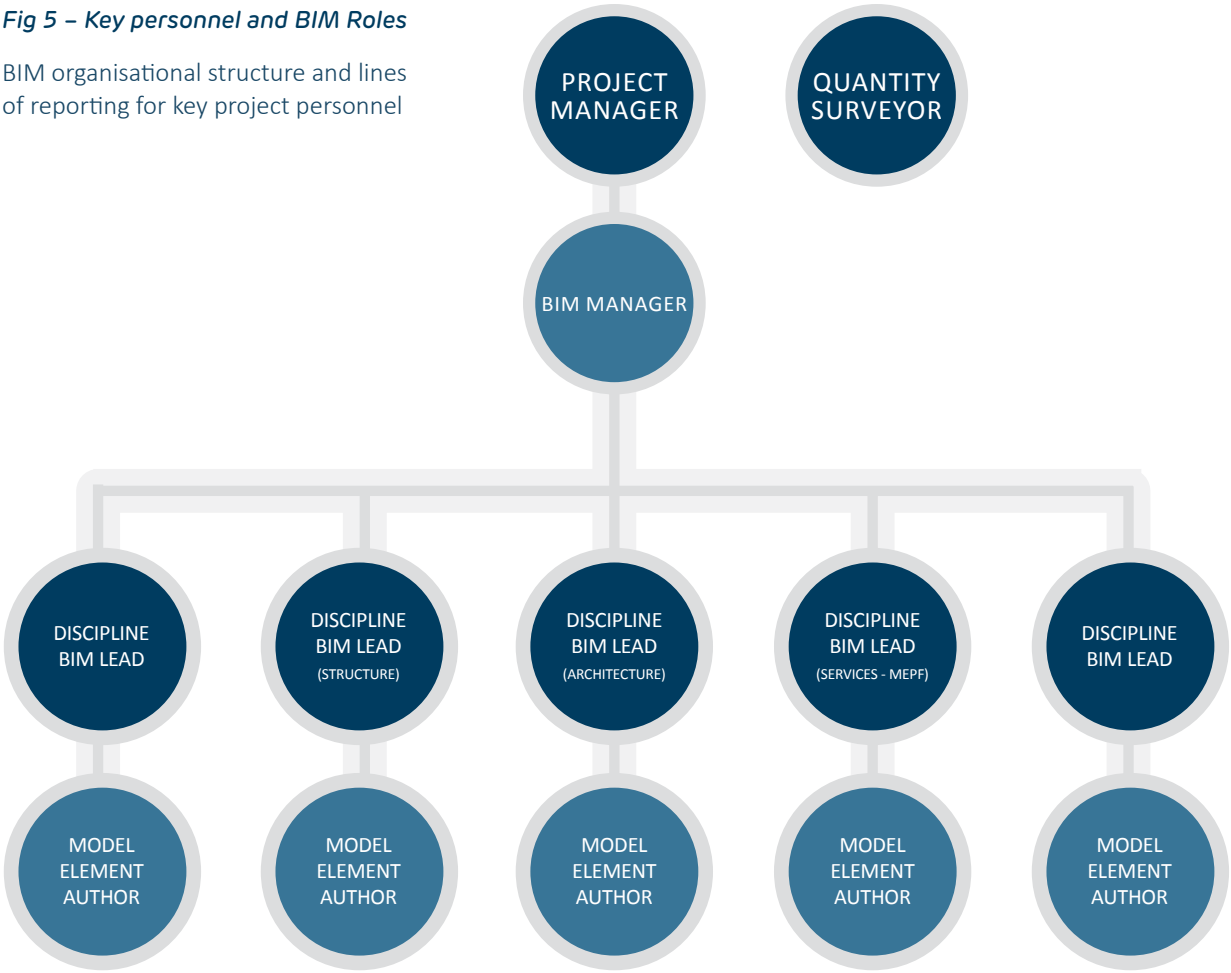
FUNCTIONS	ACTIVITIES & DELIVERABLES	CLIENT	CLIENT BIM ADVISOR (Where applicable)	BIM MANAGER (Design/Construction)	DISCIPLINE BIM LEAD	MODEL ELEMENT AUTHOR
Collaboration and General Communication	Establish the Common Data Environment	I	A	R	C	C
	Set up and drive a culture of collaboration when using BIM processes and tools on the project	I	I	A/R	R/C	C
	Facilitate BIM meetings and workshops as required during the project	C	C	A/R	C	C
	Clearly communicate information to the BIM team, Project Managers and the Design Leads as required	I	I	A/R	C	C
	Communicate design coordination issues to project stakeholders	I	I	A/R	R/C	I
	Communicate as-built/record modeling issues and progress to project stakeholders.	A	R	C	I	I
Key Meetings	BIM Requirements Kick-Off	C	C	A/R	R/C	C
	BIM Execution Plan Workshop	C	C	A/R	R/C	C
	Internal Model Coordination	I	I	A/R	A/R	C
	BIM Coordination Review	I	I	A/R	R	C
	Issue Tracking Software workshop	I	I	A/R	R	C

KEY	R - Responsible for doing the activity	A - Accountable for activity completion	C - Consulted during activity	I - Informed following activity completion

The diagram below shows an overview of a BIM organisational structure and lines of reporting for key project personnel that could be applied across different project typologies, including buildings, infrastructure and utilities. Note, each project typology is responsible for identifying the appropriate disciplines and reporting lines that fit their project procurement and organisational structure. It is impossible to provide a predetermined BIM organisation structure for all potential project typologies across the Architectural Engineering and Construction (AEC) industry.

Fig 5 – Key personnel and BIM Roles

BIM organisational structure and lines of reporting for key project personnel



Discipline BIM Leads could include:

- Architecture
- Landscape Architecture
- Structure
- Mechanical Electrical Plumbing and Fire Protection (MEPF)
- Civil
- Mechanical Plant and Process
- HV Power
- Track Design
- Seismic

2.2 BUILDING INFORMATION MANAGEMENT AND PROJECT MANAGEMENT

Client-side project directors and project managers acting on behalf of clients play a crucial role in unlocking the value of BIM processes in New Zealand, as noted in the procurement Appendix E. The chosen procurement model for a project plays a significant role in the value realisation of BIM adoption on a project.

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

3— LEGAL IMPLICATIONS OF BIM

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

3.1 CONSULTANT SELECTION

Project consultants should be provided with the EIR and other project information during the RFP process, or in the case of a two-stage procurement approach during the Registration of Interest (ROI) process. The ROI or RFP must clearly outline the client's BIM-related expectations of the consultant. Expectations should focus on specific information requirements that the client has identified. The inclusion of BIM activities for the benefit of the consultant (e.g., analysis) is secondary.

When clients have the opportunity to review the BIM evaluation and response documents, they are in a better position to select a team with the appropriate capabilities and capacity to provide the BIM delivery methodologies required for the specific project.

The RFP must detail how the BIM process will be managed and the responsibilities of individual parties. Consider the inclusion of a detailed RACI matrix to articulate responsibilities clearly. 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 capabilities of each role are separate.

When the scope or responsibilities of an organisation change during the development of a 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 the EIR and/or BIM evaluation and response documents) must clearly state deliverables and dates. However, BIM processes involve more interdependencies, which must be factored into delivery programmes.

3.2 CONTRACTOR ENGAGEMENT

The Request for Tender (RFT) process must clearly outline the client's BIM expectations of the contractor. Expectations should focus on specific information requirements 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 and could improve project outcomes.

The EIR 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

3.3 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 cannot) 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 (refer to Appendix K). 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.

3.4 INTELLECTUAL PROPERTY

In undertaking the work, the consultant/contractor uses their existing intellectual property (IP) and may develop new IP. Check which provisions of IP ownership will apply. This will be specific to the client and the commission. Note that the industry standard position in New Zealand is that any new IP will be jointly owned (as per the standard clauses in CCCS and ACENZ short form), but it may be appropriate for either the client or the consultant/contractor to own the IP and provide a broad licence back to the other party for its ongoing use. In all cases, a party continues to own its pre-existing IP, but generally grants a licence to the other party to use that pre-existing IP to the extent required to undertake the job/make use of the services. Client data is generally always owned by the client.

The clauses below document the position for new IP ownership. However, there are usually other clauses required, such as a clause covering whether (in the case of joint or client ownership) ownership is conditional on payment, and warranties around not infringing the IP of others.

1. **Jointly owned new IP:** Subject to [confidentiality obligations], all New Intellectual Property held in any medium, whether electronic or otherwise (and including any models, asset information, project information model or database), shall be jointly owned by the Client and the Consultant. The Client and the Consultant hereby grant to the other an unrestricted royalty-free licence in perpetuity to copy or use such New Intellectual Property and each Party is free to make whatever use they wish of the New Intellectual Property without any obligation to obtain the other's consent or to account for any future benefits.
2. **Client ownership of the IP:** All New Intellectual Property held in any medium, whether electronic or otherwise (and including any models, asset information, project information model or database), shall be owned by the Client. The Client hereby grants to the Consultant an unrestricted royalty-free licence to use and copy the Client's Intellectual Property provided to the Consultant to the extent reasonably required to enable the Consultant to provide the Services. This licence shall include the right to grant further sub-licences on identical terms, including to other members of the Delivery Team (Consultants, Sub-consultants) who are contracted to the Client (or contracted to the Client's: Lead Consultant, Other Consultant).

3. **Consultant/Contractor ownership of the IP:** Subject to [confidentiality obligations] all New Intellectual Property held in any medium, whether electronic or otherwise (and including any models, asset information, project information model or database), shall be owned by the Consultant/Contractor. The Consultant/Contractor hereby grants to the Client an unrestricted royalty-free licence to use and copy the Consultant's/Contractor's Intellectual Property to the extent reasonably required to enable the Client to make use of the Services. This licence shall include the right to grant further sub-licences on identical terms, including to other members of the Delivery Team (Consultants, Sub-consultants) who are contracted to the Client (or contracted to the Client's: Lead Consultant, Other Consultant).

4— INFORMATION REQUIREMENTS

Information about an asset is a key part of the BIM process. From conception to design, construction through to fabrication, installation and commissioning, the Building Information Model often contains information which directly impacts the maintainability and operability of the asset.

4.1 ORGANISATIONAL INFORMATION REQUIREMENTS

A client should be able to articulate what information is required to successfully support the operational and strategic objectives of their business. These OIR will influence how and what suppliers will need to deliver to achieve the high-level information objectives of the client. Similarly, the OIR encapsulates the information a client needs to operate their assets safely and successfully. Refer to section 5.1.2 of ISO 19650-3 for further information on defining OIRs. Annex A.2 of ISO 19650-3 provides examples of the types of activity that require asset information and example OIRs.

Most clients will use a range of Asset Management Systems (AMS) within their organisations, dependent on the criticality and maintenance required for the range of assets. These systems are often database driven and have been developed to provide the organisations with a systematic way of ensuring the assets operate as designed and procured.

As such, clients should develop Asset Information Strategies that define both current and future needs of AIR.

4.2 ASSET INFORMATION REQUIREMENTS

Clients should work with all parts of their organisations, such as Operations, FM/AM, Finance and Compliance, to develop their AIR. Clients are to communicate any AIR to other parties involved in the creation or maintenance of their assets. Refer to Section 5 of ISO 19650-1, Section 5.1.3, 5.1.4 and 5.1.5 of ISO 19650-3 for further information. Focus on the following aspects when developing an AIR:

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

4.3 INFORMATION SCHEMAS

Asset information contains a variety of common and unique attributes that define the physical and operational data related to a particular asset. The collection of an organisation’s assets and relevant attributes is often referred to as an Asset Class Library or Asset Information Schema.

Several 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. Unless the client has an existing, well-defined schema, it is suggested that they find a suitable standard information schema that aligns with their requirements.

A common mistake that organisations make is trying to capture more informational attributes than required by the relevant maintenance and operational stakeholders. This can be avoided by the client having a clear understanding of what information is required, through the BIM process, to maintain and operate their asset at the handover stage.

4.4 INFORMATION STRUCTURE

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

The New Zealand Asset 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 alongside any asset requirements that are unique to the client and well defined within their AIR

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 need to be consistent for enabling a smooth handover from project systems such as a CDE to operational systems such as an AMS. On this front, better modeling practices and standard information structures (information schemas) smooth the way for information exchange. Appendix A provides more information on modelling best practice.

The information requirements for each asset type need to be well considered and specific to the client requirements for operation and maintenance or business need; there is no easily defined list that will be appropriate for all asset types.

The BIM execution plan should reference object information and clearly assign responsibility for the creation and receipt of that information.

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

Fig 6 – 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

GRAPHICAL INFORMATION:

MEA (Model Element Authoring Schedule)
- What elements
- Delivered by whom
- Delivered by when
- Delivered to what LOD

NON GRAPHICAL INFORMATION:

Asset information requirements
- What elements
- Delivered by whom
- Delivered by when

WHAT INFORMATION:

Design	Design	Construction	Handover	Operate
ID: 402010	**ID: 402010**	**ID: 402010**	**ID: 402010**	**ID: 402010**
Category:	Category: HVAC	Category: HVAC	Category: HVAC	Category: HVAC
Make:	-	Make: Mitsubishi	Make: Mitsubishi	Make: Mitsubishi
Model:	-	Model: FCU 659	Model: FCU 659	Model: FCU 659
Location:	Location: B7 Level 1	Location: B7 Level 1	Location: B7 Level 1	Location: B7 Level 1
Room:	Room: 851	Room: 851	Room: 851	Room: 851
Design performance:	Design performance: XYZ	Design performance: XYZ	Design performance: XYZ	Design performance: XYZ
Install performance:	-	Install performance: XYZ	Install performance: XYZ	Install performance: XYZ
Install date:	-	Install date: 2019-3-1	Install date: 2019-3-1	Install date: 2019-3-1
Install by who:	-	Install by who: XYZ	Install by who: XYZ	Install by who: XYZ
Services:	-	-	-	Services: XYZ
Condition:	-	-	-	Condition: XYZ
Utilisation:	-	-	-	Utilisation: XYZ
Demand load:	-	-	-	Demand load: XYZ
Replacement cost:	-	-	-	Replacement cost: XYZ
Condition:	-	-	-	Condition: XYZ
Commissioning details:	-	-	-	Commissioning details: XYZ

DOCUMENTATION:

Project requirements
- Drawings
- Specifications
- Testing information
- Install information

Design	Design	Construction	Handover	Operate
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

4.5 ENABLING DIGITAL ASSET MANAGEMENT

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

FM/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 AMSs, 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 built assets will deliver the greatest benefit for ongoing FM/AM. By doing so, this information will form the basis of the AIR.

Refer to sections 5.1.11 and 5.1.12 of ISO 19650-3 for further information on leveraging BIM to support ongoing asset management.

4.6 MODELING BEST PRACTICE

Information must be modelled consistently to be transferred correctly from the BIM to other systems. Appendix A covers information on modeling 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.

4.7 ASSET OWNERS AND OPERATIONS AND MAINTENANCE USE

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

- The opportunity to review BIM models at each design and construction stage to confirm the building assets maintainability and operability
- 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 model
- More transparent commissioning processes, by linking final commissioning results to an As-Built BIM model or easy future retrieval
- Facilitate smoother built asset completion when using BIM in conjunction with contracted frameworks, such as CIBSE soft landings
- Enable Operations teams and Asset Managers to assess future built asset amendments using an As-Built BIM model
- Use the final BIM model for space management. Note: Rooms must be modelled as ‘spaces’ with clearly defined boundaries
- Improve built asset operating efficiency by using BIM for energy analysis
- Enable better business planning decisions

4.8 APPLYING BIM TO ASSET MANAGEMENT – CHALLENGES

Although BIM is not necessarily used during the operational stages of a built asset, it provides the AM team with well structured and quality information. This enables digitisation and better decision-making in the AM space. For most clients, there will already be a well-established AM system, and this should be considered when defining the AIRs.

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 structures and accurately specified in the EIR. A key component to successful interoperability is a well-defined and clearly communicated Asset Information Schema.

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)

4.9 THE MOVE TO COLLABORATIVE BIM

To gain the most from BIM use, internal client stakeholders must participate in a process to establish their BIM requirements. The process facilitates a transition from a passive BIM client to a more collaborative 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.

It is advised that clients consider embedding naming conventions and units of measure that align with industry standards to allow for a consistent approach to BIM across suppliers and industries.

Involving asset managers in the development of an EIR 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 EIRs that consider wider business strategies, clients are in a stronger position to drive their digital journeys to meet the future needs of their businesses.

4.10 RECOMMENDED APPROACH

Identify AIRs when the EIR is prepared and handed to designers for inclusion in the BIM execution plan. Designers and constructors should prepare the BIM so that information can be extracted later 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 Client BIM Advisor should manage this task.

5— BIM WORKFLOW

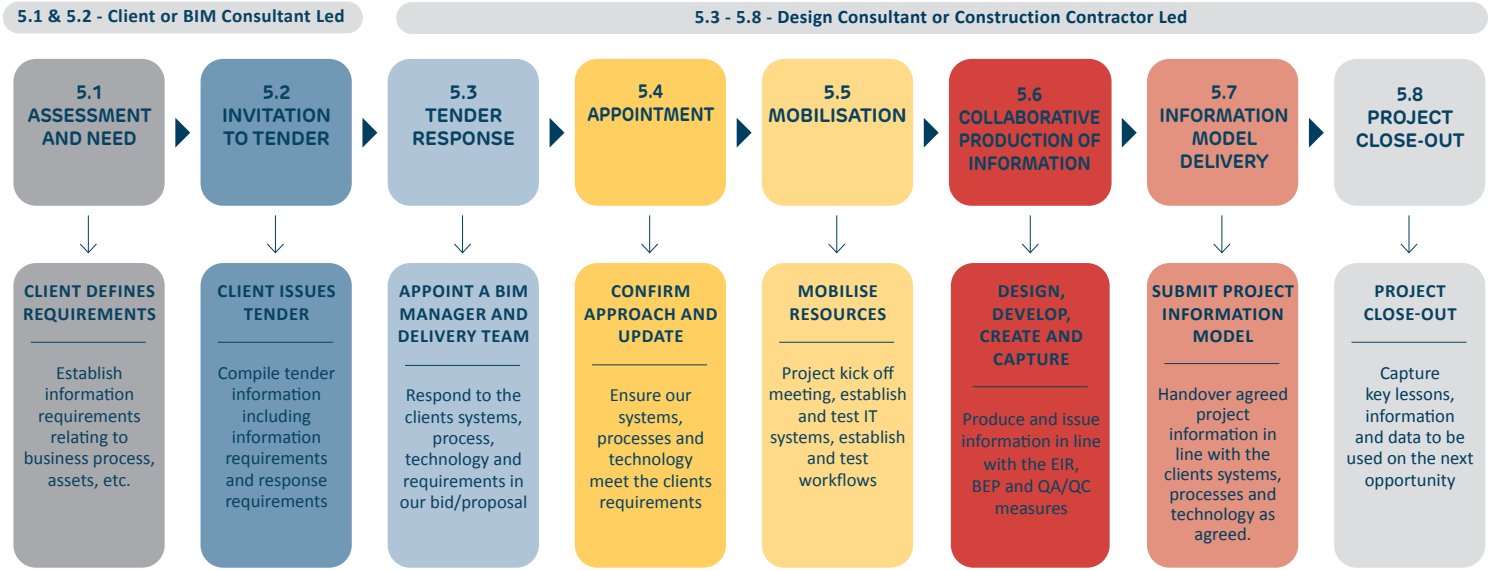
The standard BIM workflow is structured around eight high-level stages of a good practice information management process. These eight stages are generic and are applicable across a wide range of project scopes, roles and timeframes.

As seen in Figure 7, a design consultant or construction contractors' role in these eight high-level stages is often limited to:

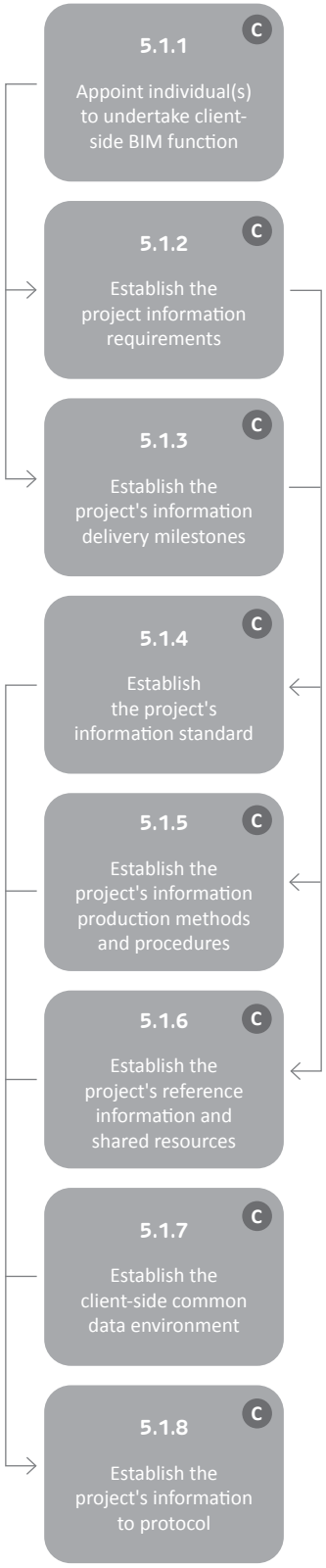
- Tender response
- Appointment
- Mobilisation
- Collaborative production of information
- Information model delivery
- Project close-out

In some circumstances, a specialist BIM consultant will be engaged by the client to act as their BIM Advisor, to undertake the Assessment and Need and Invitation to Tender steps. Refer to the table below showing a breakdown of the individual tasks within each stage.

Fig 7 – High-Level BIM Process



The following section outlines the eight stages of the BIM process in further detail.



5.1 ASSESSMENT AND NEED

During this stage, the client will define their information requirements and establish project standards. The purpose of this stage is to make sure that the client requirements are clearly defined and ready to be incorporated into the project's tender documentation.

5.1.1 Appoint individual(s) to undertake client-side BIM function

The client should nominate someone from within the organisation or appoint a third-party consultant to lead the client-side BIM process throughout the project. Tasks could include:

- Assisting with developing tender requirements
- Establishing workflows and processes
- Establishing client-side CDE
- Reviewing and approving received BIM information
- Capturing lessons learned

5.1.2 Establish Project Information Requirements

The client or client BIM advisor should establish the project information requirements in accordance with industry standards such as the NZCIC guidelines. They could include:

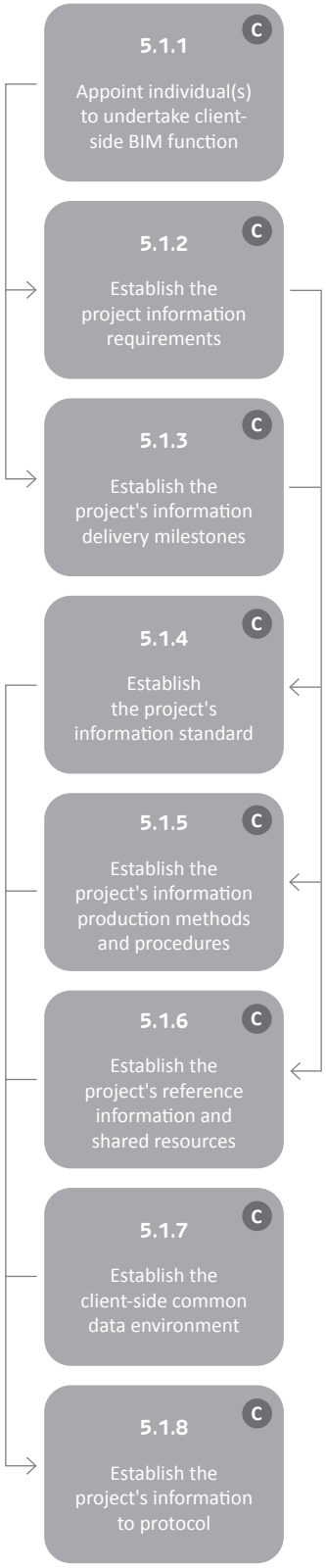
- Project scope
- What BIM information will be used for by the client, including:
- Asset Information Requirements
- As built information requirements
- Project programme
- Project procurement approach
- Project gateway/decision points

5.1.3 Establish the Project's Information Delivery Milestones

The client or client BIM advisor should establish the project information delivery milestones in accordance with industry standards such as the NZCIC guidelines and the project programme. They should consider:

- Project gateway/decision points
- Client information delivery obligations
- The type of information to be delivered at each gateway/decision point
- The dates on which information should be delivered

C **Client -** Client or Client BIM Advisor



5.1.4 Establish the Project's Information Standard

The client or client BIM advisor should establish any specific information standards the client organisation requires. These could include:

- How information is shared
- How information is structured or classified
    - Naming conventions
    - Units of measure
    - Definitions and acceptable values
- How information will be used during the operation and maintenance of the built asset

5.1.5 Establish the Project's Information Production Methods and Procedures

The client or client BIM advisor should establish any specific information production methods and procedures required by the client organisation. They could include:

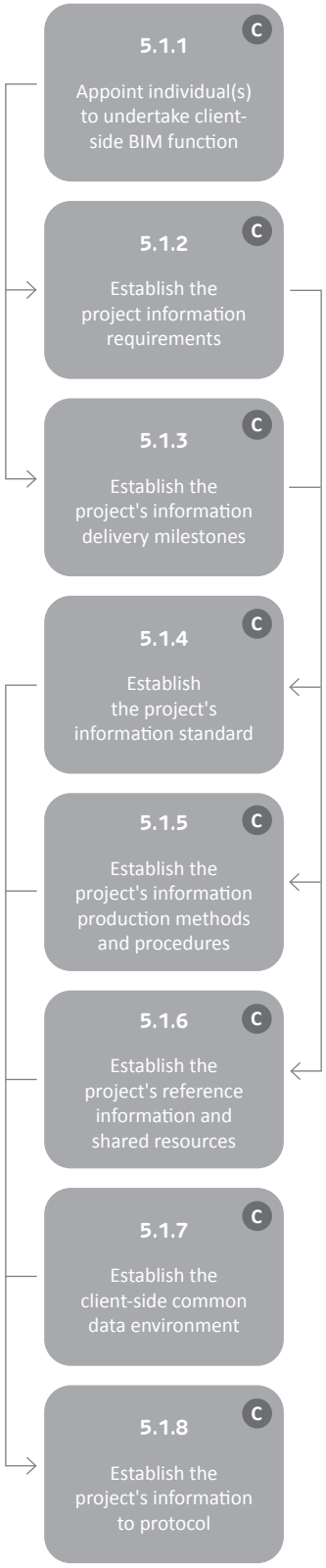
- How existing information is captured (i.e., traditional survey methods, laser scan, GPR, etc.)
- How new information is generated, reviewed and approved (i.e., specific software may be required to be used or information may need to be submitted in a specific format for review and approval)
- Information security requirements (i.e., in some instances, an online CDE platform may not be allowed to be used due to the sensitivity of project information)
- The required accuracy and tolerances for modelled information.

5.1.6 Establish the project's reference information and shared resources

The client or client BIM advisor should establish the project's reference information and resources that are going to be shared with the supply chain during the tender process.

Reference information can include:

- Existing as-built information (e.g., 2D documentation, 2D CAD files and 3D models)
- Survey information (e.g., drone data and point clouds)
- Existing GIS information
- Existing asset information
- End-of-design stage information models (only applicable at the construction contractor tender stage)
- Final design stage model coordination reports (only applicable at the construction tender stage)



Shared resources can include:

- Document templates (e.g., BIM Execution Plan template, Model Audit checklist)
- Software templates (e.g., model authoring software templates, model coordination templates)
- Object libraries (e.g., 2D symbols or 3D model objects to support model authoring and documentation)
- Style templates (e.g., line styles and text styles)

Note: Historical information can be incorrect or outdated.
Consider including clauses when sharing this information to cover:

- Whether information needs to be verified on site, or
- Whether the client is willing to accept responsibility for all reference information shared with the project team

5.1.7 Establish the client-side Common Data Environment (CDE)

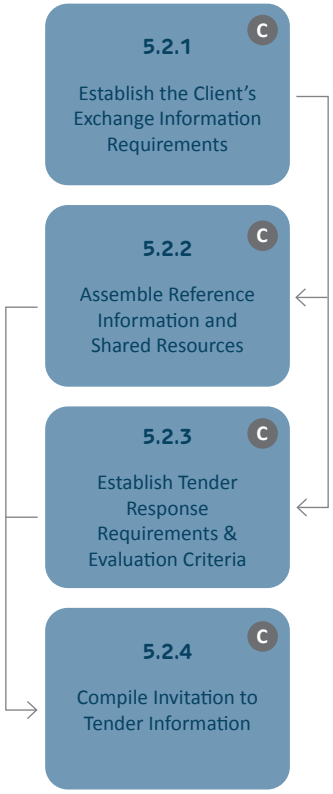
Where one doesn't exist, the client or client BIM advisor should establish the client-side CDE to support the effective management and receipt of information throughout the project. A third party can be appointed to host and manage the client-side CDE if the client does not have an environment of its own. If this option is preferred, it is recommended that the procurement of this service takes place before the procurement of any other consultants or contractors

Note: It may be agreed that the client uses the Lead Consultant's Common Data Environment rather than procuring and/or establishing their own.

5.1.8 Establish the Project's Information Protocol

The client or client BIM advisor should establish the project's information protocol with alignment to the preferred form of contract to support the effective management of BIM processes and the delivery of BIM information.

At the most basic level, contracts between the Client and a Lead Consultant, or Consultant, or Contractor require sufficient clarity about the mutual expectations for the creation, management, and exchange of information, what the information can be used for, and how the information will be structured.



C **Client -** Client or Client BIM Advisor

5.2 INVITATION TO TENDER

During this stage, the client will develop the project RFP documentation. The purpose of this stage is to ensure that the client's project BIM requirements are clearly defined and aligned across all the RFP documentation and scopes of service.

5.2.1 Establish the Client's Exchange Information Requirements

The client or client BIM advisor should establish the EIR, this will be used to set out clearly to the tenderers (at both the design and construction tender stage) what BIM information is required and what the purposes of the BIM information will be. The EIR should consider:

- Organisational, Asset and Project Information Requirements (OIR, AIR and PIR)

The EIR could include:

- The level of information need (i.e., graphical information such as LOD, non-graphical information such as asset data attributes, etc.)
- Supporting information (i.e., shared resources, reference information, exemplars of similar deliverables, etc.)
- Information delivery milestones

5.2.2 Assemble Reference Information and Shared Resources

The client or client BIM advisor should assemble all reference information and shared resources that are going to be shared with the supply-chain during the tender process. The client or client BIM advisor should consider the following:

- Sharing reference information through a secure environment such as the client-side CDE
- Communicating the reliability of the shared resources and what they can and cannot be used for during the tender process

5.2.3 Establish Tender Response Requirements and Evaluation Criteria

The client or client BIM advisor should establish the tender response requirements and evaluation criteria relating to the project BIM requirements. This could include:

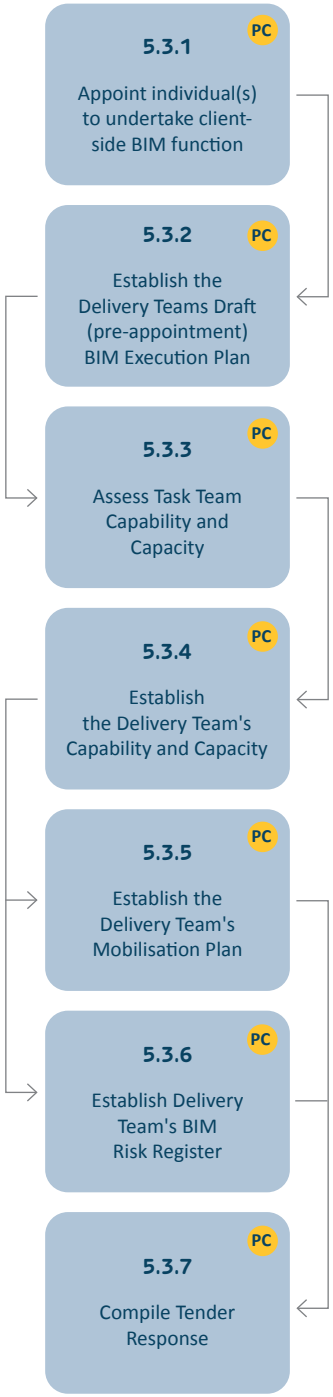
- The contents of the draft (pre-appointment) BIM Execution plan
- The BIM competency of the proposed BIM Manager, BIM lead for each design discipline or sub-contractor, or client BIM advisor, (subject to the role being procured)
- The BIM capability and capacity of the proposed team
- The contents of the proposed mobilisation plan

5.2.4 Compile Invitation to Tender Information

The client or client BIM advisor should ensure that the BIM requirements detailed above are included as part of the wider tender information

Key Recommendations:

1. It is recommended that if a project BIM Manager is going to be appointed to the project, this appointment is made before the appointment of the design consultants. This will allow the BIM manager to provide input into the procurement of other consultant, mitigating the risk of scope gaps and scope creep that is typically seen when these appointments take place in parallel, and the BIM requirements are defined via the BIM execution plan once all team members have been appointed.
2. At the construction tender stage, it is recommended that a final model coordination and clash detection report is issued as part of the tender documentation. This will assist in communicating any known coordination issues as part of the tender and allow them to be considered as part of the final tender price.



PC **Prospective Consultant or Contractor -** Architect, Engineer, Constructor, etc.

5.3 TENDER RESPONSE

During this stage, the prospective consultant or contractor will respond to the client's BIM requirements as part of the RFP process. The purpose of this stage is to make sure that the supply-chain effectively communicates its capability, capacity, and proposed approach to BIM execution on a project as part of the RFP process.

5.3.1 Appoint individual(s) to undertake BIM function

The prospective consultant or contractor should nominate an individual to lead the BIM process for their part of the project. When nominating this individual, the consultant or contractor should consider:

- The client's EIR
- The responsibilities of the role
- The capability and competency requirements for the role

Note: The BIM function could be the project BIM Manager, a discipline BIM Lead or a suitably qualified/experienced individual from within the Delivery Team.

5.3.2 Establish the Delivery Teams Draft (pre-appointment) BIM Execution Plan

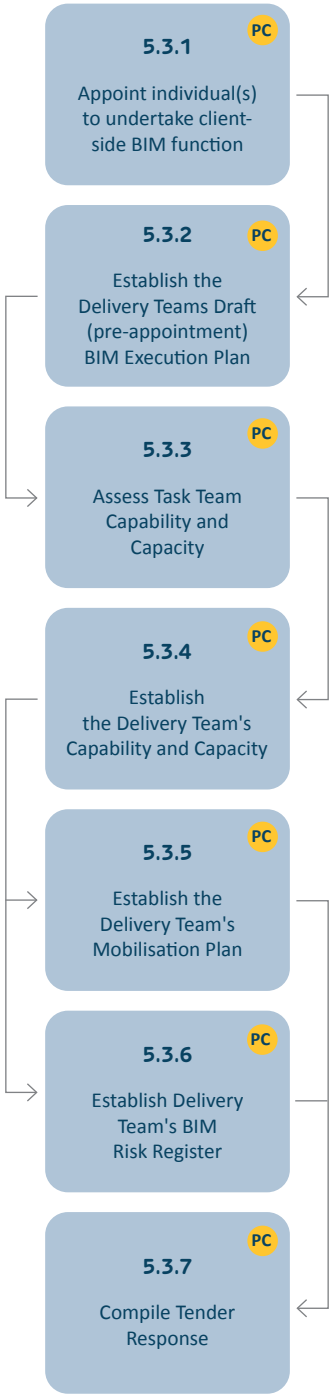
The prospective consultant or contractor should develop a draft (pre-appointment) BIM Execution Plan as part of the tender response. This will provide details on areas such as:

- Nominated personnel
- The information delivery strategy
- The model federation and coordination strategy
- High level responsibility matrix, with details on each element of the model and the key deliverables associated with each element
- Software to be used on the project

Upon appointment, the pre-appointment BIM execution plan will be agreed with the client.

Key Recommendation:

The procurement model for most projects will likely follow a traditional route, with each consultant procured individually. If this is the case, each consultant must provide their draft (pre-appointment) BIM execution plan that outlines how they intend to deliver the project. When finalising the appointments, these disparate pre-appointment BIM execution plans must be reconciled by the project BIM manager with input from the discipline BIM leads to create one overarching project BIM execution plan. Including, where applicable subject to the procurement model, the construction stage of the project.



5.3.3 Assess Task Team Capability and Capacity

The prospective consultant or contractor should undertake an assessment of their capability and capacity to deliver information in accordance with the client's BIM requirements and the proposed draft (pre-appointment) BIM Execution Plan. This could consider:

- Relevant BIM experience of team members
- Relevant project experience of team members
- Education and training available to upskill team members
- The proposed technology used by the team (software, hardware etc.)

Note: Each discipline should assess their capability and capacity

5.3.4 Establish the Delivery Team's Capability and Capacity

The key BIM personnel should be identified, and details provided on their capability in relation to the project BIM scope and their capacity for the project's duration.

5.3.5 Establish the Delivery Team's Mobilisation Plan

The prospective consultant or contractor should establish the delivery team's mobilisation plan. This could consider:

- Documenting and/or testing the information production methods and procedures
- Testing the CDE and information exchange process
- Installing and testing software
- Training requirements
- Project team briefing

Note: A company's standard procedures will often cover the software and hardware component of the delivery team's mobilisation plan, including installing and testing software.

5.3.6 Establish the Delivery Team's BIM Risk Register

The prospective consultant or contractor should establish the delivery team's risk register in relation to the project BIM requirements, detailing how the team proposes to manage any risks. This could consider:

- Assumptions relating to the EIR
- Assumptions relating to the accuracy of reference information (drawings, models and data)
- Meeting the project BIM requirements (including, where applicable, the delivery of as-built and asset information)
- Software and hardware risks
- Capacity and capability of the Delivery team to meet EIR

Note: The BIM risk register can be included as a line item in the overall project risk register.

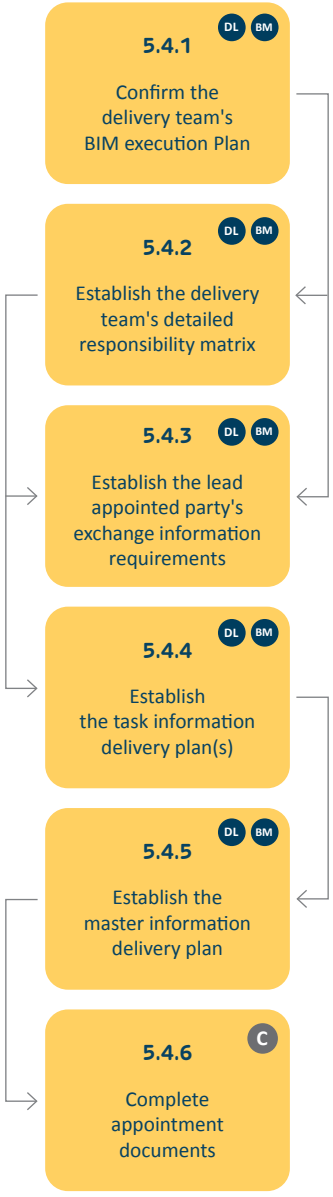
5.3.7 Compile Tender Response

The prospective consultant or contractor should ensure that (where applicable) the BIM requirements detailed above are included as part of the wider tender response information.

5.4 APPOINTMENT

During this stage, the consultant or contractor will refine and confirm the BIM execution plan, RACI and information exchange requirements. These documents, along with the client's EIR and other Project Information Requirements, will be referenced as appointment requirements. These documents will be referenced as requirements in any appointment documents between the consultant or contractor and any sub-consultants or sub-contractors.

The purpose of this stage is to avoid scope gaps by making sure that there is alignment of the various consultants and/or contractors appointed to deliver the project.



5.4.1 Confirm the Delivery Team's BIM Execution Plan

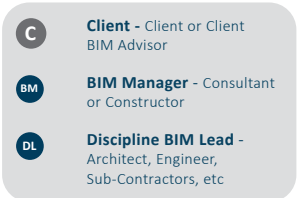
The consultant or contractor BIM manager should confirm the project BIM Execution Plan with input from each of the other consultant or sub-contractor BIM leads. This should include:

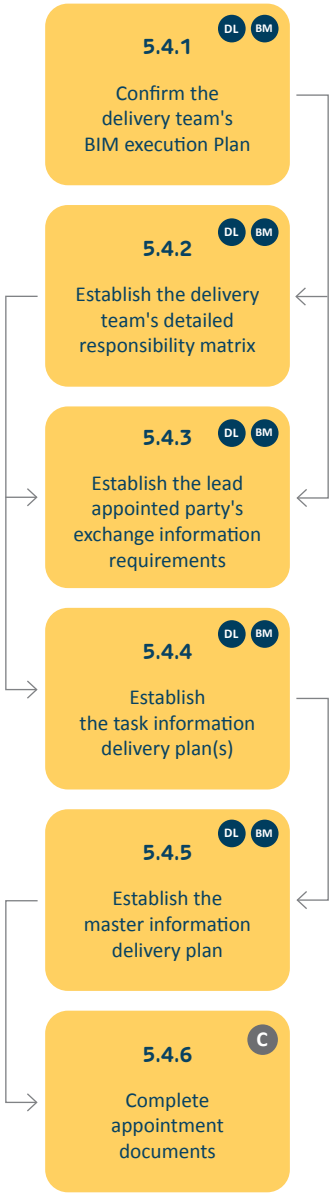
- Inputs from each consultant's disparate draft (pre-appointment) BIM Execution plan (subject to project procurement model)
- Named BIM leads for each discipline
- Updates of the RACI and information delivery strategy as required
- Detailed workflows for producing, reviewing and sharing information
- Software and other IT requirements (e.g. software versions)

Note: The client should be involved in a review and comment capacity in finalising the project BIM Execution Plan.

Key Consideration: this step typically takes place in New Zealand following the appointment to the project, resulting in scope gaps and scope creep. This risk can be mitigated if:

- The client information requirements are clearly defined and very prescriptive
- The procurement documentation is very prescriptive in terms of the BIM process that is to be followed on the project (i.e., elements to be modelled by various parties, downstream use of modelled information)
- The client carefully considers the project procurement route to mitigate the risk of BIM-related scope gaps through the project BIM execution plan being finalised post appointment





5.4.2 Establish the Delivery Team's Detailed Responsibility Matrix

The consultant or contractor BIM manager should develop the delivery team's detailed responsibility matrix, with input from each of the other consultant or sub-contractor BIM leads. This should include:

- What information is to be produced (i.e., models, drawings, data, etc)?
- Who will produce the information?
- When will the information be shared with other members of the delivery team?

Note: This is typically documented in the project BIM Execution Plan and is often a combination of a LOD matrix, an asset data schema and a project programme.

5.4.3 Establish the Lead Appointed Party's Exchange Information Requirements

The consultant or contractor BIM manager should establish its exchange information requirements; these will be used to set out clearly to the delivery team what BIM information is required and what the purposes of the BIM information will be. The EIR could include:

- The level of information need (i.e., graphical information such as LOD and non-graphical information such as asset data attributes, etc.)
- Supporting information (i.e., shared resources, reference information, exemplars of similar deliverables, etc.)
- Information delivery milestones

Note: This is typically documented in the project BIM Execution Plan. Activities 5.4.2 and 5.4.3 can be undertaken in parallel.

5.4.4 Establish the Task Information Delivery Plan(s)

Each discipline BIM lead should establish and maintain throughout the project a task information delivery plan. This should consider:

- Project deliverable milestones and key activities that require information to be shared (i.e., model federation and coordination)
- Each discipline's responsibilities
- The project information requirements
- The time needed to generate the information

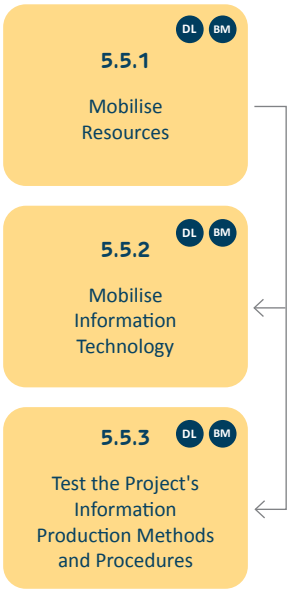
Note: Each discipline should develop a Task Information Delivery Plan. This can be documented in the project BIM Execution Plan.

5.4.5 Establish the Master Information Delivery Plan

The consultant or contractor BIM manager should aggregate the task information delivery plans from each discipline to form a master information delivery plan. This will form a baseline for information delivery on the project.

5.4.6 Complete Appointment Documents

The client or client BIM advisor should ensure that the BIM requirements detailed above are included as part of the appointment documentation for all consultants and contractors. Any changes made to the above documents should be managed via change control throughout the project's duration.



5.5 MOBILISATION

During this stage, the consultant or contractor will confirm resources, hardware and software and test the information production methods and procedures. The purpose of this stage is to ensure that resources are appropriately briefed, IT systems are in place and information production methods and processes are established before commencing work on the project.

5.5.1 Mobilise Resources

The consultant or contractor BIM manager should mobilise the resources as defined in the delivery team's mobilisation plan in Section 5.3.5. This could include:

- Facilitating an introduction to the project
- Highlighting key milestones
- Confirming availability of resources for each delivery team
- Sharing and describing the information requirements
- Undertaking any training that is required

Note: Activities 5.5.1 and 5.5.2 can be undertaken in parallel.

5.5.2 Mobilise Information Technology

The consultant or contractor BIM manager should mobilise the IT as defined in the delivery team's mobilisation plan in Section 5.3.5. This could include:

- Purchasing new software or hardware
- Configuring and testing the project CDE, including the sharing and delivery of information across the delivery team and with the client.

Note: IT mobilisation will often be covered by a company's standard procedures for purchasing, installing and testing software and hardware.

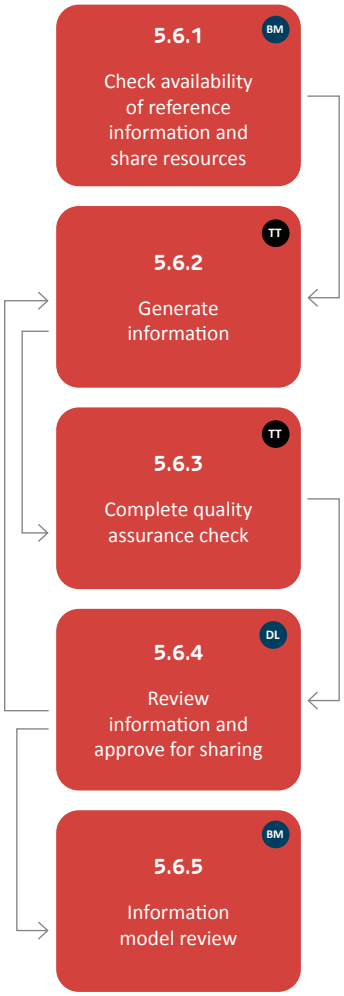
5.5.3 Test the Project's Information Production Methods and Procedures

The consultant or contractor BIM manager should test the project's information production methods and procedures as defined in the delivery team's mobilisation plan in Section 1.3.5. This could include:

- Testing and refining documented procedures
- Developing shared resources for use by the delivery team (i.e., workflows and other procedures)
- Communicate the production method and procedures to the wider delivery team

BM **BIM Manager** - Consultant or Constructor

DL **Discipline BIM Lead** - Architect, Engineer, Sub-Contractors, etc



5.6 COLLABORATIVE PRODUCTION OF INFORMATION

During this stage, the consultant or contractor will confirm that all reference information is available, generate design or construction information in accordance with the EIR and project information requirements and verify information before sharing with others. The purpose of this stage is to make sure that the consultant or contractor efficiently creates, verifies and delivers BIM information in accordance with the client's requirements.

5.6.1 Check Availability of Reference Information and Shared Resources

The consultant or contractor BIM manager should check that the delivery team has access to the relevant reference information and shared resources (in accordance with Section 5.1.6) within the project's common data environment.

5.6.2 Generate Information

Each discipline should generate information in accordance with the agreed project BIM execution plan and any supporting documentation, such as:

- The project information standard
- The project's information production methods and procedures

5.6.3 Undertake Quality Assurance Check

The Model Element Author for each discipline should undertake a quality assurance check of their model files to check alignment with the project BIM Execution Plan and the project's information production methods and procedures.

5.6.4 Review Information and Approve for Sharing

The BIM lead for each discipline should undertake a quality assurance check of their model files before sharing them via the Common Data Environment. This review should consider:

- The project BIM Execution Plan requirements
- The information needed for coordination with other disciplines

Once complete, the BIM lead for each discipline should:

- If the review is successful:
  - Approve the information for sharing with the consultant or contractor BIM manager
  - At key project milestones, complete a Model Description Document to communicate what the model information can be used and relied upon for
  - Suitability codes for the use of information can also be used to communicate how information can be used
- If the review is unsuccessful:
  - Record why the review was unsuccessful and communicate any required changes to the Model Element Author

5.6.5 Information Model Review

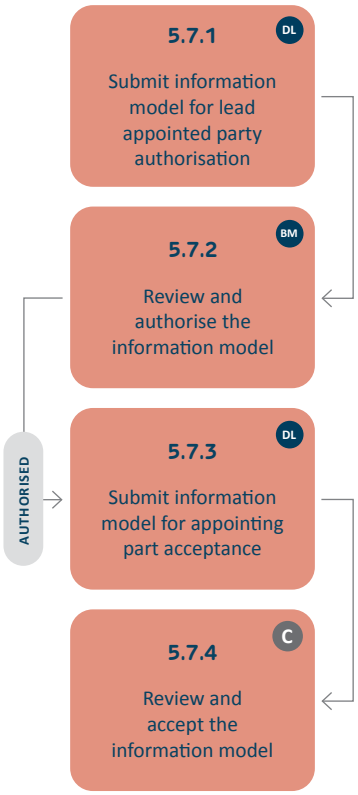
The consultant or contractor BIM manager should undertake a thorough review of the Federated Building Information Model in accordance with the project BIM execution plan and any supporting documentation. This can include:

- An audit of the model and non-graphical data against the project BIM Execution Plan requirements
- A model coordination/clash detection review

BM **BIM Manager** - Consultant or Constructor

DL **Discipline BIM Lead** - Architect, Engineer, Sub-Contractors, etc

TT **Task Team** - Design Disciplines / Sub-Contractor trades



5.7 INFORMATION MODEL DELIVERY

During this stage, the consultant or contractor will review the federated model and non-graphical data and confirm that they meet the project requirements. Following the review, the model and non-graphical data will be submitted to the client for approval. The purpose of this stage is to make sure that the federated model is reviewed and verified before issue.

5.7.1 Submit Information Model for Lead Appointed Party Authorisation

All design consultants should submit their information models to the consultant or contractor BIM manager via the project CDE.

5.7.2 Review and Authorise the Information Model

The lead consultant or contractor BIM manager should review the information model in accordance with the project BIM execution plan. During this process, the consultant or contractor BIM manager should consider:

- The Master Information Delivery Plan
- The Exchange Information Requirements
- The level of information need for the project stage (i.e., graphical information such as LOD, non-graphical information such as asset data attributes, etc.)

Note: This review can be undertaken using a simple requirements checklist or similar.

Once this review is complete, the consultant or contractor BIM manager should:

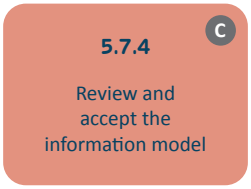
- If the review is successful:
  - Instruct the discipline BIM leads to submit their information model to the client via the project CDE
- If the review is unsuccessful:
  - Record why the review was unsuccessful and communicate any required changes to the discipline BIM lead.

Note: If the consultant or contractor BIM manager rejects the information model deliverable, the discipline BIM lead should revert to Section 5.6.

5.7.3 Submit Information Model for Appointing Party Acceptance

Each discipline BIM lead should submit their information model to the client for review and acceptance via the project CDE. This could also include a federated model, which is submitted by the consultant or contractor BIM manager. Each model should be accompanied with:

- A Model Description Document to communicate what the model information can be used and relied upon for
- A model audit report or similar (if applicable)
- A model requirements checklist or similar (if applicable)
- The final model coordination/clash detection report



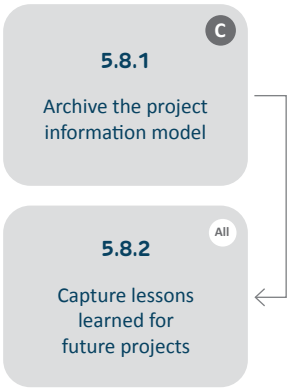
5.7.4 Review and Accept the Information Model

The client or client BIM advisor should undertake a review of the information model in accordance with the project BIM execution plan. During this process, the client or client BIM advisor should consider:

- The Master Information Delivery Plan
- The Exchange Information Requirements
- The level of information needed (i.e., graphical information such as LOD, non-graphical information such as asset data attributes, etc.)

If the review is successful, the client or client BIM advisor should accept the information model as a deliverable. If the review is unsuccessful, the client or client BIM advisor should reject the information model as a deliverable, record why the review was unsuccessful and communicate any required changes to the consultant or contractor before the information model is re-submitted.

Note: If the client or client BIM advisor rejects the information model deliverable, the consultant or contractor should revert to Section 5.6



5.8 PROJECT CLOSE-OUT

During this stage, the client or client BIM advisor and/or the consultant or contractor will archive the information model and undertake an end-of-project review. The purpose of this stage is to make sure that information is archived correctly and lessons learned are captured to inform future projects as part of a continuous improvement process.

5.8.1 Archive the Project Information Model

Upon acceptance of the information model, the client or client BIM advisor and/or the consultant or contractor should archive their respective components of the project information model. They should consider:

- What information will be needed for ongoing asset management purposes
- File formats (i.e., native files or open file formats)
- Future access requirements, including future use and re-use

5.8.2 Capture Lessons Learned for Future Projects

A BIM workshop should be undertaken with all parties to capture lessons learned for future projects.

Note: It is recommended that lessons are captured progressively throughout the project.

C **Client -** Client or Client BIM Advisor

All **All Parties**

6— 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 EIR and be engaged to deliver models aligned to these expected uses. Consider the following factors as construction requirements are pushed back into design:

- Modeling to a construction level takes more time – and cost. Investigating multiple options at this level of detail is not always efficient, but ultimately coordination to this level must be undertaken ahead of construction.
- Construction level detailing may be product-specific, in which case competitive supply differentials between contractors no longer apply, however this may be offset by other time or quality advantages.
- Contractor-preferred construction methodologies may differ.

Project procurement must evolve to maximise the benefits of BIM. Overseas evidence shows the greatest scope for overall modeling efficiency comes from integrated project delivery (IPD), early contractor involvement, 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 EIR
- 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 judgements
- Ensure design models clearly identify what they can – and can't – be used for; and how they align with the contracted requirements in the EIR
- 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 the requirements of the EIR are being met
- Ensure appropriate value has been assigned to As-Built/handover information and the progressive collection of this information throughout construction

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 re-purposing.

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 EIR 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 regarding 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 Modeling (BIM) (process) – A collection of defined model uses, workflows, and modeling methods used to achieve specific, repeatable, and reliable information results from the model. Modeling methods affect the quality of 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 focused 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.

Exchange Information Requirements (EIR) - The EIR 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 EIR is to be provided as part of the RFP/RPF documentation set.

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.

MEPF – Mechanical, Electrical, Plumbing and Fire Consultancy.

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.

RACI Matrix – used to clarify roles and responsibilities for each task, milestone and decision on a project.

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.

Request for Proposal (RFP) – is a formal request from a client asking respondents to propose how their services can achieve a specific outcome and meet their budgets, most commonly used to procure consultancy services, i.e., Architect, Engineer, Project Manager.

Request for Tender (RFT) – is a formal request from a client asking for tenders to provide goods or services, most commonly used for the procurement of Contractors.

Record modeling – 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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