Building Information Modelling (BIM)

Exchange Information Requirements (EIR)

May 2024

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1 Introduction

The Department of Transport and Main Roads (the department) has developed its Building Information Modelling (BIM) processes and methodology based on the principles outlined in ISO 19650 *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling* suite of documents, for the management of information during the capital / delivery phases of infrastructure projects.

Transport and Main Roads utilisation of standardised processes, data and enabling technologies supports the strategic plan for BIM delivery across all projects. Transport and Main Roads Exchange Information Requirements (EIR) outlines the requirements for the way information and data should be managed and supplied to Transport and Main Roads to support and enhance outcomes in both project delivery and activities beyond handover including operations and maintenance. The EIR is a key tendering document in providing clarity around the information requirements and level of information needed for Transport and Main Roads approval and acceptance.

2 Purpose and scope

This Exchange Information Requirements can be used across the different contract types used by the department during the procurement phase for projects in both design and construction. It is applicable during Business Case, Preliminary and Detailed Design and further into Transport Infrastructure Contracts for construction.

The purpose of this document is to outline the processes and practices that provides direction to the lead appointed party on what BIM deliverables must be delivered under the contract, the information requirements that must be met, and the production of a BIM Execution Plan (BEP) and supporting documentation that demonstrates how the lead appointed party will address the department's information requirements.

Irrespective of contract type, BEPs will be required in both the design and construction phases, either as individual documents or as a combined design / construction BEP.

A central part of the department's BIM strategy is the creation and maintenance of an Asset Information Model (AIM). The AIM is not simply a 3D model of an asset but a dynamic repository of asset data, with attributes assigned to modelled objects, providing essential information to various actors throughout the project lifecycle, from the design and construction phases to the management of the asset post-completion.

In order to achieve that outcome, there is a need to develop the Project Information Model (PIM).

While the PIM is a broad concept of capturing project information developed during design and construction, at its core, the PIM must contain a number of information containers including a 3D federated building information model, non-graphical data such as model object attributes, and associated documentation.

The PIM supports the delivery of the project and contributes to the AIM to support asset management activities purposes.

To facilitate the efficient implementation of BIM on our projects, the department will leverage the collaborative processes, tools, and technologies outlined in this EIR. These resources, adhering to ISO 19650, will aid the department in optimising BIM usage for not only enhanced project delivery, but also maintaining a high standard of asset management. Adherence to this standard underlines the pivotal role of information as a key deliverable in the department's BIM implementation and asset management strategies.

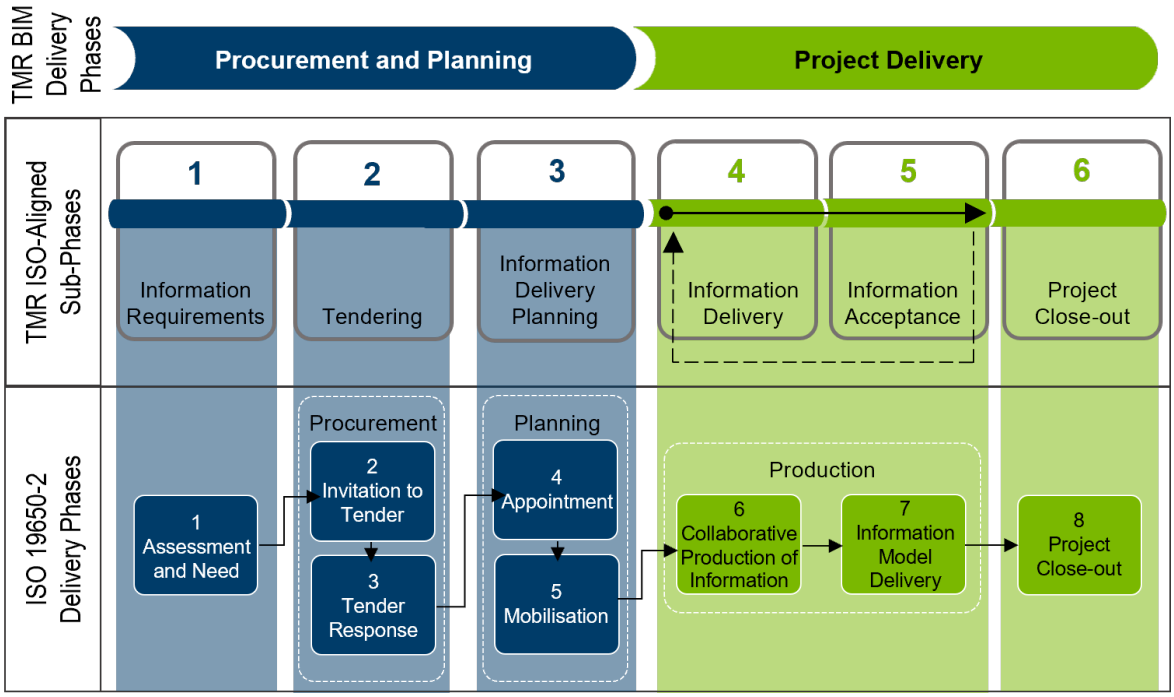
There are a number of concepts that define the level of information need that will be exchanged. These include geometrical information, alphanumerical information, and documentation.

Transport and Main Roads requires asset information attributes to be assigned to modelled objects that provides the required level of information to actors during the design, construction, and asset management phases of an asset lifecycle.

The information provided may feed into other processes, such as cost estimation during the design phase, asset management information systems that store road inventory and road reference data, GIS mapping applications that are used within the department's iMAPS systems, and as quality assurance records of the As Constructed infrastructure.

The ISO 19650-2 *Delivery phase of the assets* makes clear three primary management areas during the delivery of a project, each with their own phases. These are Procurement, Information Planning, and Information Production.

Figure 2 – Transport and Main Roads BIM delivery phases aligned against the ISO 19650-2 information management phases



3 Definition of terms

The following are terms used in this document or in common usage in discussion about BIM.

Table 3 – Definition of terms

Term	Definition
3D attributed model	A 3D model that has attributes / data attached to objects. The attributes can be used to extract information into a database or table format. In relation to the ISO 19650-1 definition of an information model, Transport and Main Roads are focussed on the 3D attributed model component with respect to this EIR. All documentation requirements are as per contract and Transport and Main Roads requirements.
A Road Management Information System (ARMIS)	A bespoke Transport and Main Roads information management system made up of multiple sub-systems, ARMIS provides a data warehouse and a number of presentation and analysis tools. The information within ARMIS includes road location, road inventory, pavement condition, traffic data, crash history and routine maintenance performance contracts and so on. These systems capture and store the information, which is then fed into the data warehouse for retrieval using the presentation tools.
Appointed party	Is typically comprised of the task team commonly referred to as the sub-consultant / sub-contractor. A member of both the project team and a delivery team. The appointed party may include a number of task teams within it. According to ISO 19650-1 the appointed party is a provider of information concerning works, goods or services.
Appointed party – Task Team Discipline BIM Lead	Leads the BIM processes for their discipline.
Appointing party	Is the client, in this case Transport and Main Roads, responsible for owning the appointment / project. Primarily focused on providing the information requirements for the project and reviewing and approving the information supplied by the delivery team. The appointing party is considered a member of the project team. According to ISO 19650-1, the appointing party is a receiver of information concerning works, goods or services from a lead appointed party.
Asset Information Model (AIM)	Information model relating to the operational phase. (Refer to ISO 19650-1)
Asset Information Requirement (AIR)	Defines the specific information and data which must be delivered, along with the delivery format, to achieve Transport and Main Roads target state AIM. (Refer to ISO 19650-1)
Asset Information Management Systems (AIMS)	A suite of departmental IT systems (i.e. ARMIS, ROAR, BIS, etc.) that supports asset management.
BIM Execution Plan (BEP)	A formal document that is submitted by the proponents during a tender process outlining how they intend to meet the BIM requirements defined in Transport and Main Roads EIR. (Refer to ISO 19650-2) The BEP must be updated in line with trigger events throughout the life of the project.

Term	Definition
Building Information Modelling (BIM) (Process)	BIM is a process for creating and managing information of a built asset throughout its whole life cycle from planning, design, construction, operations, maintenance through to demolition. Information containers may take the form of 2D, 3D, or other structured or unstructured data sources. The effective and efficient use of BIM for decision support and achievement of desired project outcomes is impacted by "when" and "why" information is used and shared.
Bridge Information System (BIS)	A bespoke Transport and Main Roads information management system as part of the larger Bridge Asset Management System (BAMS). The objective of the BAMS is to establish effective business processes for the management of structures and to support this goal by an integrated and accessible information system. The BAMS includes: • development of an overarching policy for the management of structures, • development of an inspection methodology and manual for structures, • improvement of the processes involved in determining load carrying capacities of structures, and • implementation of the BIS. The purpose of the BIS is to support the BAMS by providing an integrated and accessible information system, containing comprehensive quality information on structures.
Common Data Environment (CDE)	A central repository where design and construction project information are housed. The contents of the CDE are not limited to information created in a 'BIM environment' and it will therefore include documentation, graphical models and non-graphical assets.
Computer Aided Design (CAD)	A geometric / symbol-based computer drawing system that replicates hand drawing techniques.
Container naming convention	A standard structured, consistent and understandable naming convention / information identification convention. The ISO 19650 series recommended principles are to be adopted: 1. Each information container should have a unique identifier, based upon an agreed information identification convention, which comprises a string of data fields. 2. Each information identification field is to be assigned a value from an agreed and documented codification standard.
Deliverables	The product of engineering and design efforts to be delivered to the appointing party as digital files and/or hardcopy documents. A deliverable may have multiple phases.
Delivery team	The delivery team is responsible for the production of the information requested by the appointing party under the contract and is comprised of resources from the lead appointed party and their appointed parties. (Refer to ISO 19650-1).
Exchange Information Requirements (EIR)	A key document intended to be part of the wider tender document set for the procurement of the design team and the constructor.

Term	Definition
Federated model	A single shared model resulting from combining the various individual discipline models and other data sources that do not lose their identity or integrity by being combined. The individual discipline models must remain the primary data source of information at all times throughout the contract.
Geographical Information Systems (GIS_	A computer-based system that captures, stores, analyses, and presents spatial and geographic data, aiding in the planning and management of various projects and resources.
iMAPS	Transport and Main Roads Interactive Mapping Solution (iMaps) – A Transport and Main Roads facing, browser based interactive mapping solution which integrates spatial and non-spatial data from both internal and external suppliers. It is tightly integrated into a range of Transport and Main Roads business processes and utilises Oracle Spatial, the ESRI technology stack and GeoCortex.
Industry Foundation Class (IFC)	A system of defining and representing standard architectural and construction-related graphic and non-graphic data as 3D virtual objects to allow data exchange among BIM tools, cost estimation systems, and other construction-related applications in a way that preserves the ability to perform analysis on those objects as they move from one BIM system to another. IFC files saved or exported from BIM-authoring software can be used for the following tasks: • coordination of BIM models and related design disciplines • carrying asset attributes for data extraction • clash detection • rules-based checking • sharing models between different BIM-authoring software • energy testing data derived from BIM models, and • systems simulation.
Information	Reinterpretable representation of data in a formalised manner suitable for communication, interpretation or processing.
Information management	Supports the data standards and data requirements for BIM use. Data continuity allows for the reliable exchange of information in a context where both sender and receiver understand the information.
Information model	As defined by ISO 19650-1, an information model is a coordinated set of structured and unstructured information containers in the form or geometric models, attribute data and/or documentation. The term ‘project model’ is also referenced on occasion i.e. within the *Drafting and Design Presentation Standard Manual* and is relating to a 3D attributed model.
Information modelling	Information modelling is a sub-set of BIM and relates to the production and use of digital models that represent built assets.
Interoperability	The ability of two or more systems or components to exchange information and to use the information that has been exchanged.

Term	Definition
Lead appointed party	Is the party responsible for co-ordinating information between the delivery team and the appointing party (client). The lead appointed party is a member of both the project team and a delivery team. Commonly referred to as the consultant / contractor.
Lead appointed party – BIM Manager	Responsible for leading and implementing the BIM systems and processes to meet the project exchange and information modelling requirements.
Lead appointed party – Discipline BIM Lead	Leads and coordinates the BIM processes for the delivery team.
Lead appointed party – Project Manager	Retains overall control of the project program, deliverables, and communication with appointing party and appointed parties.
Level of development (LOD)	The department has adopted the use of this term to define the level of geometric model detail i.e. graphical representation of model geometry ranging from simplified (for space saving, e.g., LOD 200) to detailed (for visualisation e.g., LOD 300).
Level of information (LOI)	The department has adopted the use of this term to define the level of attribute data information i.e. non-graphical information or data associated to model geometry e.g. object name, object location, object material type, etc.
Level of information need	The level of information need is a framework, as defined by ISO 19650-1, which helps to define the minimum information requirements of 3D attributed models with respect to requirements outlined for each Transport and Main Roads delivery phase. The department has adopted the use of this term to consist of level of development (LOD) and level of information (LOI).
Map Grid of Australia (MGA)	A coordinate system based on the Universal Transverse Mercator projection and the Geocentric Datum of Australia. The unit of measure is the metre.
Master Information Delivery Plan (MIDP)	This is a term referred to in ISO 19650-2 which is a full schedule of information model deliverables for a project to be prepared by the lead appointed party. The MIDP should include all geometric, asset data and documentation deliverables. For Transport and Main Roads, this is captured by the work breakdown structure for the schedule of activities to include key information delivery milestones.
Model Production Delivery Table (MPDT)	The MPDT is a schedule of models which the delivery team, including the task / discipline teams, intend to create. The MPDT is to be coordinated and issued to the appointing party by the lead appointed party prior to commencing with model production.
Model use	A unique task or procedure on a project which can benefit from the application and integration of BIM into that process.
Project Information Model (PIM)	Information models including documentation, non-graphical information and graphical information developed during the design and construction phases of a project in response to requirements set out in the EIR. Information model relating to the delivery phase. (Refer to ISO 19650-1).

Term	Definition
Project Information Requirements (PIR)	Defines the specific information requirements for the project, (for example, specific requirements beyond the AIR / EIR, timing requirements and any specifics relating to information delivery and transmission. (Refer to ISO 19650-1).
Project team	The project team has responsibility for the overall management of the project and is comprised of resources from the appointing party, the lead appointed party and all appointed parties. (Refer to ISO 19650-2).
Road Operations Asset Register (ROAR)	A bespoke Transport and Main Roads asset register which holds asset related data for Intelligent Transport Systems and Electrical (ITS&E), Traffic Survey Data Management (TSDM), busway and tunnel assets.
Supplier	The provider of information concerning works, goods or services.
Task Information Delivery Plan (TIDP)	The TIDP is a subset of the MIDP to be produced by all appointed parties and coordinated to form the MIDP. According to ISO 19650-2 TIDP is a schedule of information containers and delivery dates, for a specific task team.
Task team	Task teams are teams focused on undertaking particular packages of work relating to discipline or task and is comprised of resources from the appointed parties. (Refer to ISO 19650-1).
Technical Publications	Are Transport and Main Roads documents published on the Technical Publications webpage, or Internal Publication Series.
Transport and Main Roads	Also referred to as Department of Transport and Main Roads, the department, the client, or the appointing party.
Transport and Main Roads BIM delivery phases	The three primary delivery phases, Procurement and Planning, Project Delivery, and Operations and Maintenance that provide the overarching guidance to the eight corresponding ISO 19650-2 Section 4 *Information management during the delivery phase of assets aligned sub-phases*. These BIM delivery phases are not to be confused with delivery stages / submission gates within the development phase of a project.
Transport and Main Roads – BIM Information Manager	Leads and coordinates the appointing party BIM processes for the project.
Transport and Main Roads – BIM Reviewer	Review and comment on the BEP. Ensure relevant discipline models comply with the EIR. Approve graphical models and design artefacts developed.
Transport and Main Roads – Project Manager	Retains overall control of the project program, deliverables, and communication for the appointing party.

4 Reference documents and standards

The following documents are to be read and understood prior to responding to this EIR:

- Transport and Main Roads Functional Specifications for Consultants for Engineering Projects (CFEP) relevant to project phase.
- Transport and Main Roads Transport Infrastructure Contract (TIC) suite of contract documents relevant to contract type.

- Transport and Main Roads *Drafting and Design Presentation Standards Manual* (DDPSM).
- Transport and Main Roads *TMR Surveying Standards* manual.
- Transport and Main Roads Technical Specification MRTS56 *Construction Surveying*.
- *Building Information Modelling (BIM) for Transport and Main Roads Guideline.*
- *Building Information Modelling (BIM) for Bridges Manual.*
- *Transport and Main Roads object attributes for bridges*, and
- ISO 19650 *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling* suite of standards.
  - ISO 19650-1 *Concepts and principles*
  - ISO 19650-2 *Delivery phase of the assets*
  - ISO 19650-3 *Operational phase of the assets*
  - ISO 19650-4 *Information exchange*
  - ISO 19650-5 *Security-minded approach to information management*
- ISO 16739 – *Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries*, and
- BS EN 17412-1 *Building Information Modelling. Level of Information Need*

5 Building Information Modelling Execution Plan (BEP)

To meet the requirements of the department's BIM implementation framework, the lead appointed party must create and issue to the appointing party a BEP for the contracted scope of works. A BEP must be developed for both pre-appointment and post-appointment tender submissions.

The department has published a *BIM Execution Plan Template* that the tendering party / lead appointed party must use in response to the EIR.

Pre-appointment BEPs should focus on the proponents BIM experience highlighting their ability to respond to ISO 19650-2 Section 5.3 *Information management process – Tender response*.

In particular the response should focus on:

- nominating individuals who will undertake the information management functions
- outlining the delivery team's capability, capacity and experience, and
- outlining the delivery team's mobilisation plan.

Key considerations to be included in the post-appointment BEP and clearly explained by the lead appointed party in context of the contracted scope of works should include:

- Clarification that the EIR and the relevance of BIM to the project is clearly understood by the lead appointed party.
- Identification of the lead appointed party roles and responsibilities and approach to stakeholder engagement.

- An approach to the coordination, quality, and assurance reporting & exchange of information models.
- Clarification of the proposed CDE approval workflows and enabling technology solution and what access will be provided to the appointing party.
- Clarification of the proposed enabling technologies for the production, review, approval and exchange of models and other information containers, and the plan for mobilisation and ongoing support.
- Clarification of the proposed container naming conventions, file formats, and the proposed approach to file and model object identification for both the production and exchange of model information.
- Clarification around the approach for file, model and data subdivision and coordination amongst various stakeholders and disciplines.
- Clarification that the acceptance process and criteria are both understood and will be well-managed by the lead appointed party and what quality control measures and assurances will be in place.
- Identification of the relevant project standards, methods & procedures that the lead appointed party will adhere to for the duration of the contracted scope of works, and
- Clarification of the relevant model uses and what approach, tools and model data the lead appointed party intends to use for the contracted scope of works and how the appointing party may interact with the process and information outputs.

Documents required to be submitted by the lead appointed party include:

- A BEP to be updated and issued to the appointing party for acceptance prior to commencement of any information production. The BEP should be a live document, subject to regular reviews and updates based upon any further information, changes to scope, planned approach or resources with respect to the delivery team and issued by the lead appointed party.
- A lead appointed party Roles and Responsibilities Matrix in relation to the delivery and management of BIM by the lead appointed party throughout the contracted scope of works.
- A MPDT to clarify specific models to be produced, their discipline or sub-discipline, model object author, the level of development of objects within the model, and which model uses this will support.
- A Model Object Attributes Matrix clarifying what attributes will be included and associated with discipline specific 3D models at each stage of the project.
- A MIDP that outlines when project information is to be prepared, who is the responsible officer, and what information will be delivered at each milestone. This plan should be developed by the lead appointed party and incorporate all relevant task information delivery plans.
- A TIDP that outlines a list of deliverables by each discipline lead, including format, who is the responsible officer, and when the task will be delivered. This plan should be developed by the discipline leads of each task.

- A delivery team BIM Capability and Capacity Statement to provide assurances around the lead appointed party's ability to deliver and manage information throughout the contracted scope of works, and
- A lead appointed party BIM Risk Register to communicate key BIM related risks identified by the lead appointed party including how they will be managed.

These considerations are covered in more detail throughout the following sections.

6 Organisation structure, roles and responsibilities

This section aligns to ISO 19650-2 Section 5.3.1 *Nominate individuals to undertake the information management function*.

The lead appointed party shall have regard to the effective management of information throughout the appointment by nominating individuals from within its own organisation to undertake the information management functions on behalf of the lead appointed party.

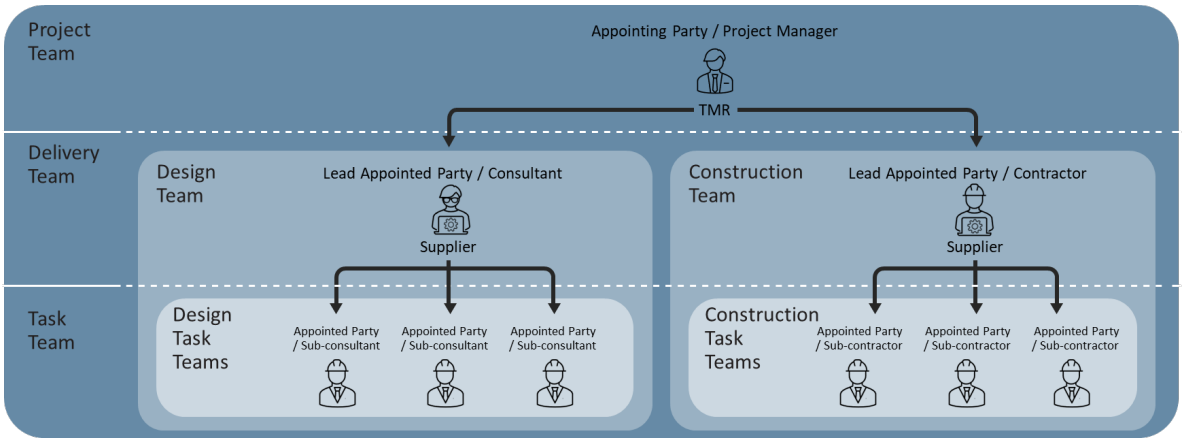
The lead appointed party shall establish the delivery team's BEP, to be included within their tender response.

In doing this, the lead appointed party shall provide:

- an overview of the delivery team's organisational structure and commercial relationships
- the proposed names and roles of the key project personnel who will undertake the information management functions on behalf of the delivery team, and
- an overview of the delivery team's composition, in the form of one or more task teams.

The lead appointed party will liaise with the appointing party to identify the nominated client representatives who will take on project and BIM related management roles and responsibilities under the contract. Any Roles and Responsibilities Matrix produced in the BEP shall include both appointing and appointed party representatives.

Figure 6 – An example of potential parties and their teams typically found in a design or construction project depending on the contract type.



The lead appointed party should advise the appointing party of any change to nominated project personnel, roles or responsibilities outlined in the BEP. Any such change will trigger a review and updated submission of the BEP.

The lead appointed party's information modelling skills and experience must match the required information modelling deliverables and be outlined in the lead appointed party's BEP. The lead appointed party must demonstrate how they will acquire the required Information modelling skillset for the full design production and construction supply chain.

7 Collaboration

This section aligns to ISO 19650-1 Section 6.3.4 *Information is drawn from the whole delivery team* and Section 12 *Common data environment (CDE) solution and workflow*.

Efficient and regular communication between the appointing party and the lead appointed party is essential to the running of the information modelling based project review processes. Regular project collaboration between disciplines (virtual and in person) is required and must be incorporated into the lead appointed party’s BEP.

7.1 Meeting schedules

Regular communication meetings shall be scheduled and detailed within the BEP and must include:

- An initial BIM kick start meeting, the purpose for which shall be for the lead appointed party to outline their approach for executing BIM in collaboration with Transport and Main Roads.
- BIM coordination meetings shall be arranged ahead of each milestone (Initial, Preliminary, and Detailed Design submissions, Issued for Construction, and As Constructed submissions) with Transport and Main Roads. These meetings shall be facilitated by the lead appointed party's BIM Manager using the federated model, if required, to review and inform the project team of progress and identify any issues or concerns with the model. A separate schedule of collaboration meetings will need to be defined to track the As Constructed model development during the construction phase, and
- Additional BIM progress meetings shall be scheduled as required, to inform the appointing party's project team of progress and identify any issues or concerns with the model or design.

The individual discipline models and the federated model shall be updated by the lead appointed party to be presented at the regular collaboration meetings with the appointing party's BIM Information Manager. The lead appointed party’s BIM Manager and the lead appointed party’s Discipline BIM Lead must attend the collaboration meetings. Issues shall be highlighted in the collaboration software, recorded in the minutes of meetings, and distributed for resolution.

7.2 Common data environment (CDE) for information production

A CDE solution and workflow shall be used for managing information during project delivery.

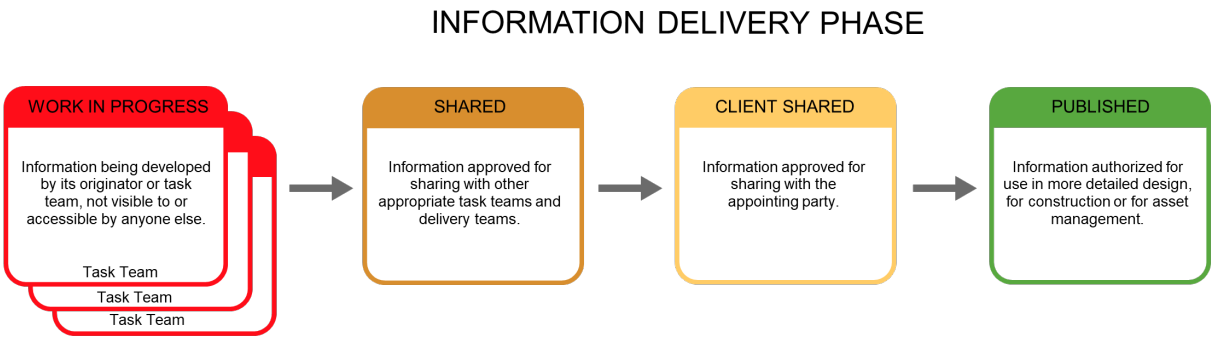
The CDE is vital to provide a central repository that improves the creation, sharing, and issuing of information that underpins the delivery of the project.

It enables all project stakeholders to access, manage and share information effectively.

The contents of the CDE are not limited to assets created in a 'BIM environment' and it will therefore include documentation, graphical models, and non-graphical information.

During the delivery phase, the CDE solution and workflow should support the information management processes in ISO 19650-2 Sections 5.6 *Information management process – Collaborative production of information* and 5.7 *Information management process – Information Model Delivery*.

Figure 7.2 – Information containers as per the information delivery phase



The department has a mandated workflow solution to manage file transfer between the department and an infrastructure project lead appointed party / appointed party. All contractual correspondence, design submissions including reports, drawings, 3D attributed models and other files submitted for review, and file transfer notifications are to be sent via the nominated system as advised by the appointing party.

7.2.1 CDE workflow for approval and exchange

It is the responsibility of the lead appointed party to:

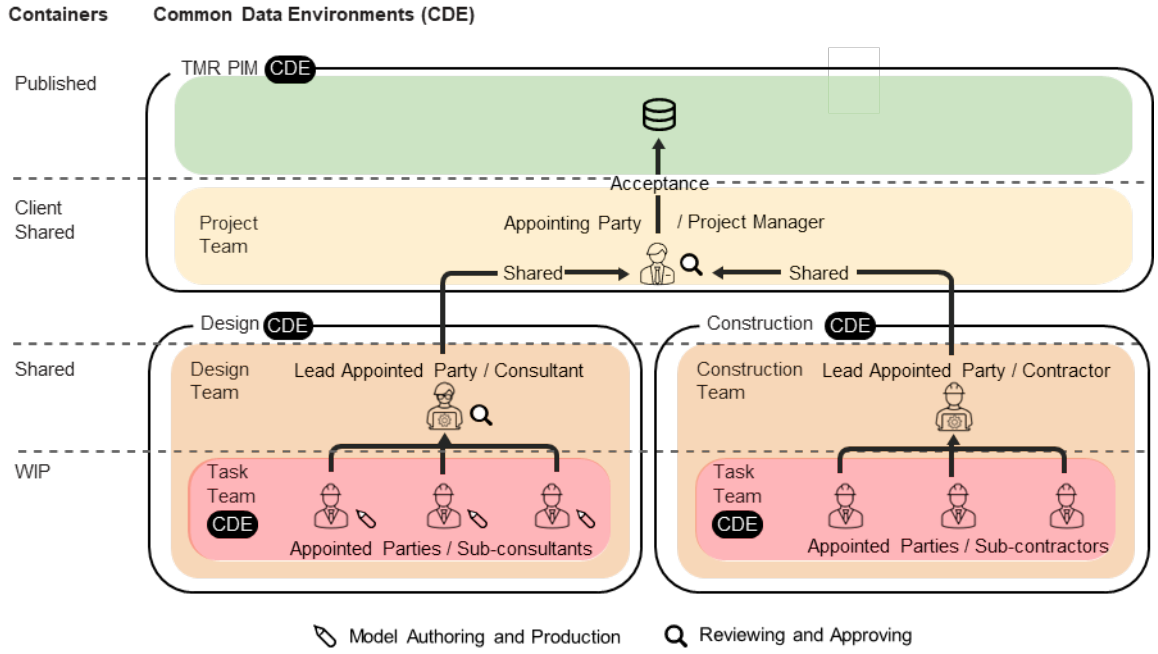
- Review, understand and determine the relevance of any Transport and Main Roads technical documents and Technical Specifications in conjunction with the contracted scope of works and in establishing a secure connection to the CDE solution for the project delivery team.
- Ensure alignment with container naming conventions, approval workflows and object attribute requirements with any of the enabling technologies that form part of the CDE for the project.
- Make available via the CDE any shared discipline and federated models as and when they are deemed suitable for appointing party review, including for approval at key project milestones and stage gates.
- Ensure that an audit trail for the approval of models from a technical content and file container perspective is maintained and provided if required by the appointing party, and
- Outline how information will be exchanged between the lead appointed party's task teams and the appointing party's CDE.

A diagrammatic representation of the information workflows internally within the lead appointed party environment linking to the appointing party CDE must be provided to demonstrate how the information exchange will occur.

Information managed in the CDE should be understandable by all parties supported by:

- defined information formats
- defined delivery formats
- an outline of the structure of the federated model
- the use of the "client shared state" of the CDE to include information approved for sharing within task and delivery teams and with the appointing party, and
- an outline of the process for the collaborative production of information and delivery of the individual discipline or federated models.

Figure 7.2.1 – CDE Workflow hierarchy for projects delivery



8 Model management

8.1 Information production and coordination

> This section aligns to ISO 19650-2 Section 5.6 *Information management process – Collaborative production of information*.

Transport and Main Roads do not specify the methodology the appointed parties use to create design and construction information but require clarity in relation to the methods and enabling technologies to be utilised to support interoperability and collaboration where required. The approach should be captured, agreed through acceptance of the latest approved lead appointed party's BEP, and be change controlled accordingly. The following requirements relate to the production and coordination of 3D attributed models during the delivery of the contracted scope of works for the project:

a) The lead appointed party must ensure that models are produced and coordinated in compliance with the project's information standard, and in accordance with the project's information production methods and procedures.

b) The lead appointed party must make available via the agreed CDE any shared discipline and federated models as and when they are deemed suitable for appointing party review, including for approval at key project milestones and stage gates.

c) The lead appointed party must ensure that an audit trail for the approval of models from a technical content and container naming convention perspective is maintained and provided as required by the appointing party.

d) The appointing party and the lead appointed party must establish agreed common BIM standards.

e) The appointing party and the lead appointed party must establish agreed project data exchange protocols including the following:

- workflow environment
- method of information modelling data exchange (shared data environment / temporary shared area / web access), and
- open data exchange formats.

f) In addition to this, common modelling standards must be established by the lead appointed party and accepted by the appointing party. Areas of consideration include:

- modelling methodologies
- level of information need
- incorporation of meta data, and
- use of attributes.

g) The lead appointed party must maintain the individual discipline models with regular updates so that it adequately represents the current design or construction status. The models must include only the latest version of the modelled objects the lead appointed party is responsible for, and must not reference to external models, reference surfaces or context.

8.2 Survey control

The Horizontal coordinate datum for all new Transport and Main Roads surveys shall be the Geocentric Datum of Australia 2020 (GDA2020) and implemented in the relevant zone of the Map Grid of Australia (for example, GDA2020 / MGA Zone 56).

All survey heights shall be based on the Australian Height Datum.

8.3 File naming convention

All files and models should be consistently identified as per the agreed project information standards for file transfers to the appointing party under the client shared / published arrangements of the CDE. All files must follow a consistent naming convention throughout each design submission stage and during construction as outlined below.

Figure 8.3 – Transport and Main Roads file naming convention

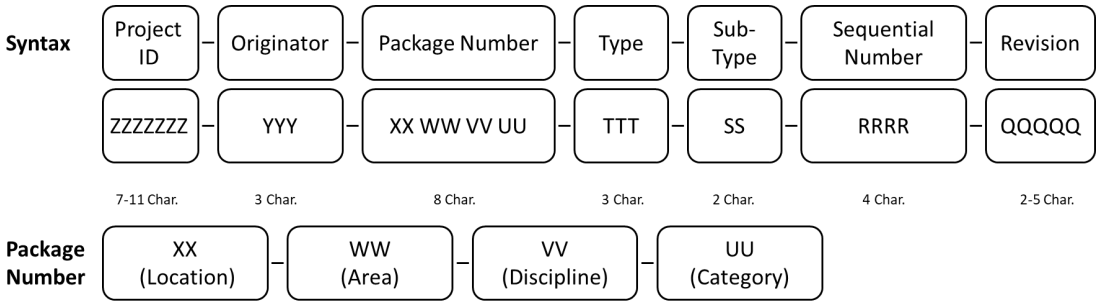


Table 8.3 Transport and Main Roads file naming convention field descriptions

Field	Description
Project ID (7-11 characters)	The project identifier the information container relates to, e.g. IPMWR2D, CN19520.
Originator (3 characters)	The party responsible for producing the information container (as defined in the detailed responsibility matrix), e.g. TMR, DJV, CJV.
Location (2 characters)	The spatial aspect of the project the information container relates to. For example: specific work area within project extents e.g. global, early works, motorway, local roads.
Area (2 characters)	Additional spatial aspect of the project location if necessary, default 00.
Discipline (2 characters)	The (technical) branch of the industry responsible for producing the information container. For example: civil engineer, structural engineer, drainage engineer, surveying.
Category (2 characters)	The functional aspect of the project the information container relates to. For example: road alignment geometry, hydrology assessment, intelligent transport systems.
Type (3 characters)	The type of information contained in the information container. For example: model, drawing, general correspondence, report.
Sub-Type (2 characters)	The sub-type of information contained in the information container. For example: pavement model, site plan, technical note.
Sequential Number (4 characters)	A sequential / grouped number to make the ID unique when the codes in the other fields are otherwise the same.
Revision Number (2-5 characters)	The status of the information container to keep track of revisions that are shared by a task / project team, e.g. PO1.1, PO2 (pre-contractual revision) in WIP or Shared state, CO1, CO2 (contractual revision) in Published state.

8.4 Civil discipline model object codes

Where possible civil infrastructure components within specific discipline model files should be clearly identified by the use of unique object codes, as outlined below in Figure 8.4.

The unique object codes should be included as one of the attributes assigned to the modelled object.

Figure 8.4 – Example of the object coding for civil infrastructure

Project ID = Ipswich Motorway Rocklea 2 Darra (IPMWR2D)

Control Line = MC1A0

Discipline = Pavements (PA)

Object Code = ML1A (Pavement configuration label)

Unique Number = 0001

Refer to the *Building Information Modelling (BIM) for Transport and Main Roads Guideline* for the department's unique object codes.

The full BIM object codes for bridges can be found in the *Building Information Modelling (BIM) for Bridges Manual*.

8.5 Model formats

All file formats should be outlined in the BEP for review, approval or acceptance prior to issuing to the appointing party.

The lead appointed party shall outline the model authoring, information transfer, and model file viewing formats to be used in the development and delivery of all models, drawings and associated documents necessary to meet the BIM requirements for the project.

A table showing the design discipline, native application, native file format and exchange formats shall be included in the BEP.

Figure 8.5 shows the common design authoring and file exchange formats used by the department.

Figure 8.5 – Examples of key file formats for documentation and 3D attributed models

8.6 Model quality checking

The lead appointed party is responsible for ensuring that models produced by the delivery team are coordinated and controlled prior to delivery to Transport and Main Roads.

The status and approval of model files is essential for providing the required assurances and clarity in relation to the status and intent of any 3D attributed models shared or issued with the appointing party.

The lead appointed party should outline how they will ensure model quality through the application of review processes including:

- Design coordination meetings
- Interdisciplinary design reviews
- Level of information data requirements checking

- Clash detection, and
- Issue tracking and resolution.

Further to these requirements, consistent governance in relation to the following is required:

- Model identification – use of consistent model naming convention
- Model formats – confirm model formats align with appointing party requirements, and
- Model segregation and validation for exchange.

9 Information exchange

This section aligns to ISO 19650 2 Section 5.7.2 *Review and authorize the information model* and 5.7.3 *Submit information model for appointing party acceptance*.

The process for transferring electronic files between the appointed party (if applicable), to the lead appointed party and then to the appointing party shall be agreed with the appointing party and defined in the project BEP.

In doing this, the lead appointed party shall provide to the appointing party the delivery team's information delivery strategy, containing:

- the delivery team's approach to meeting the appointing party's exchange information requirements, including the CDE
- a response to the appointing party's BIM objectives / goals for the collaborative production of information, and
- an outline of both the TIDPs and MIDP aligned with the appointing party's schedule for deliverables.

Electronic files shall include reports, drawings, and models, in native file format for each file type or agreed open standard for document exchange.

Models shall be provided in both native file and an Industry Foundation Class (IFC) format for each discipline model and form the basis for the development of a federated model.

At each submission the lead appointed party must provide a model file register that outlines the names of the models delivered, complying with the Transport and Main Roads file naming convention, and the model objects that they contain.

A clash detection matrix should be developed and included in the BEP that outlines the discipline specific clash detection schedule planned for the project and at what stage this will be undertaken. A Clash Detection Report is to be provided as part of the model file submissions.

The lead appointed party shall ensure that the appointing party is constantly and consistently informed of design progression at all times.

9.1 Development stages

9.1.1 Design

BIM coordination meetings with Transport and Main Roads during the design phase shall be arranged ahead of each milestone (Initial, Developed, Certified Design, and Issued for Construction). It should be noted that the stages shown below relate to the level of design effort required to achieve a deliverable in any of the project development phases of Business Case, Preliminary Design, or Detailed Design.

To provide guidance, the following milestones are to be applied during all design delivery stages:

- Initial Design:
  - drawings and models that outline the design intent through the development of the initial horizontal and vertical alignment compatible with the proposed speed environment
  - consideration of design elements of required general arrangement layouts as identified in earlier Concept or Options Analysis project development phases, for example, intersections / interchanges, bridges / major drainage structures etc
  - typical carriageway definition including traffic lane, auxiliary lane, and shoulder widths, and batter slope selection options
  - initial consideration of pavement depth based on knowledge of traffic types and volumes from earlier Concept or Options Analysis project development phases
  - general drainage considerations for all drainage systems
  - early identification of existing Public Utility Plant location and consideration of additional survey requirements for future clash resolution, and
  - early identification of bridge design criteria including general arrangement details that need to be shared within the project team.
- Preliminary Design:
  - analysis of horizontal and vertical alignment coordination intended to fix the alignment to allow other disciplines to commence / continue design with confidence
  - drainage development including both cross and longitudinal drainage
  - introduction of other disciplines designs for example, street lighting, traffic signals, and ITS&E
  - consideration of additional road furniture for example, kerb and channel, safety barriers, fences, noise barriers, signs and so on
  - refined design of any Public Utility Plant requirements and continued engagement with relevant authorities
  - development of bridge design models and drawings as per the *BIM for Bridges Manual*
  - federation of discipline specific models should begin, and identification of clash detection requirements undertaken for major disciplines, and

  - unique object codes, or full BIM object codes for bridges, and associated attributes, or placeholders for specified attributes, have been assigned to all relevant objects in the BIM model submissions.

- Detailed Design:
  - at Detailed Design submission the technical design of models and drawings should effectively be complete
  - horizontal and vertical alignment and roadway element widths should be finalised
  - finalisation of drainage design models and drawings including all cross drainage and longitudinal drainage
  - finalisation of pavement design models and drawings
  - finalisation of roadside furniture modelling, including guardrail, barriers, signs, and fences and gates
  - finalisation of all structural modelling including bridges, retaining walls, and other structures
  - finalisation of lighting, traffic signals, and ITS&E models and drawings, and
  - unique object codes, or full BIM object codes for bridges, and associated attributes have been assigned to all relevant objects in the BIM model submissions.
- Issued for Construction / Permission to Use
  - Resolution and close-out of any modelling, drawing, documentation issues raised in the Detailed Design submission that are required to undertake the final set-out, construction, and information exchange requirements under the contract.

9.1.2 Construction

BIM coordination meetings with Transport and Main Roads shall be arranged ahead of each appropriate construction milestone as negotiated with the contractor during construction to deliver the As Constructed attributed models.

- As Constructed model submission
  - In addition to the standard deliverables of As Constructed records outlined in the department's MRTS56 *Construction Surveying*, MRTS50 *Specific Quality System Requirements*, and the *Drafting and Design Presentation Standards Manual*, the As Constructed records must include the results of As Constructed surveys conducted by a qualified surveyor including:
    - As Constructed digital models, on the project datum in 12D ASCII format
    - a federated As Constructed 3D attributed model of the constructed works developed from the As Constructed survey suitable for viewing in a model file viewer
    - asset attributes as outlined in *Building Information Modelling (BIM) for Transport and Main Roads Guideline* and the *Transport and Main Roads object attributes for bridges* are to be assigned to the objects in the models

- As Constructed survey of completed construction lots in an Industry Foundation Class *.ifc 2x3 open file format, and
- any As Constructed 3D attributed models showing details of the completed works including Public Utility Plant constructed and/or relocated to AS5488 *Classification of Subsurface Utility Information* (SUI) quality level A.

9.2 Model segregation and validation for exchange

The lead appointed party must have in place suitable procedures for model data validation for both issuing and receiving building information modelling data.

Procedures for model data validation for both issuing and receiving information modelling data must include:

- model transmittal documentation that provides an audit trail of the sharing of models between parties
- a model file register of each of the discipline models delivered at each submission
- model validation documentation that demonstrates the validation of the contents of the model against a pre-determined schedule of model objects and attributes, and
- records that demonstrate usage of the procedures.

The lead appointed party shall ensure the integrity of any file transfer prior to the final delivery. Objects within the models must be tagged and adequately attributed to comply with the appropriate level of development.

9.3 Model Production Delivery Table (MPDT)

To enable the required information exchange, the lead appointed party must document a MPDT in the BEP that is consistent with the information exchange requirements and be accepted by the appointing party. The purpose of this matrix is to plan and communicate the collective information modelling deliverables to the appointing party. It must address the following items:

- what is the information model that will be delivered
- when each model object is being modelled and delivered
- the level of detail to which each object shall be modelled, and
- who the responsible project team members are for model objects at each stage.

The level of information may vary depending on the ultimate purpose the information is required for and the specific requirements at each delivery milestone. In some instances the same information may be used for a number of different purposes.

Road transport infrastructure projects require a level of information that provides enough detail to allow the project to:

- be set-out in accordance with defined engineering principles
- contain information that informs cost scheduling and analysis through the provision of quantity of materials and material description
- allow for clash detection between specified discipline model objects

- provide geometric information that clearly defines the model object's location in real world coordinates, and
- provide sufficient inventory information, i.e. property sets, to identify the object for inclusion in the department's asset classification systems.

The property sets shall be created and displayed as separate tabs in the properties window within an IFC model file viewer, for selected objects. The property sets are defined in the *Building Information Modelling (BIM) for Transport and Main Roads Guideline* Object Attributes Table and the *Transport and Main Roads object attributes for bridges*, published on the departmental website. For objects not listed in either document, the lead appointed party shall prepare and submit attribute schedules for these objects to suit the needs of the project, as part of their BIM Execution Plan.

All required attributes shall be applied to the objects in the models and displayed on a dedicated "DTMR attributes" property set.

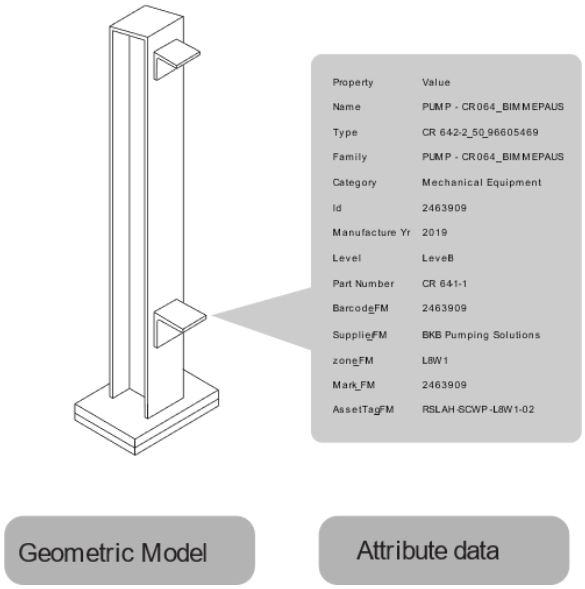
9.4 Level of information need

The department has defined a list of attribute requirements that outline the level of information needed to satisfy both the asset information requirements and the project information requirements for each object in the models.

Level of information need consists of:

- Level of development (LOD) – Level of geometric model detail i.e. graphical representation of model geometry ranging from simplified (for space saving, e.g., LOD 200) to detailed (for visualisation e.g., LOD 300), and
- Level of information (LOI) – Level of attribute data information i.e. non-graphical information or data associated to model geometry e.g. object name, object location, object material type, etc.

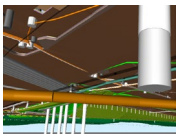
Figure 9.4(a) – Example of typical LOD (Geometric Model) & LOI (Attribute data)



The level of information need, comprised of the LOD and LOI required, is to be defined at each stage gate as part of the MPDT.

The below table shows an example of the 3D attributed model developed against the Transport and Main Roads submission gates. Note that the MPDT should be the governing guidance for model production and the EIR should act to inform the MPDT.

Table 9.4 – Level of information need (LOD & LOI) example against submission gates

Transport and Main Roads Submission Gate	Initial Design Submission	Preliminary Design Submission	Detailed Design Submission	As Constructed Submission
Example Graphical Representation				
Submission Gate Deliverables	3D object models with horizontal and vertical alignment of control lines and major roadway elements.	3D object models with additional discipline models added to the roadway model.	3D object models of all discipline models.	3D object models of all discipline models, field verified As Constructed.
LOD (Geometric Model)	LOD 200 Approximate quantities, size, shape, location, and orientation of modelled objects.	LOD 200 / LOD 300 Various discipline objects will be developed to different levels of LOD at this stage.	LOD 300 Accurate quantities, size, shape, location and orientation.	LOD 500 Field verified representation from the As Constructed survey, accurate quantities, size, shape, location and orientation.
LOI (Attribute data)	BIM object codes required as a minimum.	Attributes or attribute placeholders have been applied for major disciplines and displayed on a dedicated “DTMR attributes” property set.	All required attributes have been applied to the objects in the models and displayed on a dedicated “DTMR attributes” property set.	All required attributes have been applied to the objects in the models and displayed on a dedicated “DTMR attributes” property set.

For Transport and Main Roads production phases and their governing stage gates see Section 9.1.

It is anticipated that the model will evolve over the life of the project in accordance with the levels of information need as defined by Transport and Main Roads, and described below:

a) BIM processes must be implemented during all contracted stages and clearly documented and updated to reflect any changes in the lead appointed party’s BEP, which should include the following:

   – Create, manage, and implement a BEP that meets the requirements outlined in this document.

- Utilise enabling technologies and collaborative processes to establish and manage a CDE that must provide secure and controlled access to the Administrator and other approved Transport and Main Roads representatives. The CDE will be used to view and interrogate shared and published data made available as part of the review process at nominated and agreed times. Design and construction review and data exchange milestones should be outlined in the BEP.
- Apply the requirements of the department's relevant standards and specifications to the production and delivery of information for the asset disciplines and project stages in line with the contracted scope of works, and
- Develop and use an information model which includes spatial data and attributes used to convey the design and construction intent and stores in a digital format the attributes of each object in the relevant discipline models including but not limited to:
  - Civil infrastructure:
    - Road formation
    - Road furniture
    - Pavements
    - Drainage
    - Noise barriers
    - Public Utility Plant
  - Electrical infrastructure:
    - Lighting
    - Traffic signals
    - ITS&E, and
  - Structures:
    - Bridges
    - Retaining walls
    - Major culverts
    - Gantries
    - Tunnels and other structures.
- Refer to the department's *Building Information Modelling (BIM) for Transport and Main Roads Guideline* for the attribute requirements of each of the discipline specific model objects to be included in the models outlined above.

b) Data must be exchanged between the design and construction teams, the lead appointed party, and the appointing party including the design and construction reviewers using the 3D attributed models.

c) Apply the EIR to the information exchange submissions defined in this document, the Functional Specifications and other contract documentation.

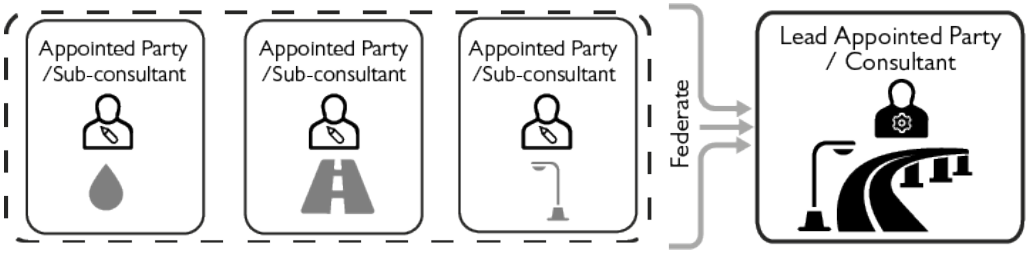
d) If the information modelling requirements cannot be met, for example due to a technical obstacle, the lead appointed party must obtain permission to propose an alternate approach or to omit the modelling of the required object in writing from the appointing party.

e) The lead appointed party must create and maintain a federated model of each of the discipline models developed at each stage.

f) The lead appointed party's BIM Manager must confirm with the appointing party which discipline models the appointing party requires to be included in the project specific federated model at various project stages relevant to the contracted scope of works, and

g) The lead appointed party must ensure that its appointed parties (sub-consultants/sub-contractors) apply all appropriate information modelling methodologies, coordinated on a single federated model, to achieve the information modelling requirements set out in this document.

Figure 9.4(b) – The concept of multiple task team's discipline specific models being federated



10 Model uses and outputs

The proposed approach by which the lead appointed party implements information model uses should be clearly documented in the lead appointed party's BEP and in particular relation to the project scope.

Key information model uses and key deliverables associated with each are summarised below. The lead appointed party should consider which are relevant for their scope of works and how they propose to manage each use case or those proposed in addition to those below within their post-appointment BEP.

The following are model uses which Transport and Main Roads deem valuable to enhance the delivery of projects and to support better outcomes into operations and maintenance. The lead appointed party should consider the applicable model use, their approach, and clearly articulate this as part of their BEP submission and revise accordingly if this approach should change.

Table 10.1 – Existing conditions modelling

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To provide an accurate understanding of above and below ground assets and conditions.	The origin and prior governance of any information relied upon. Any prior interpretations that may have been made. What standards and levels of accuracy were referenced in the capture and production of information about existing assets and site conditions.	• Surface modelling. • Sub-surface modelling. • 3D feature lines. • 3D objects with attributes. • Digital Terrain Model (DTM) or contour models.

Table 10.2 – Design authoring and development

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To enhance the coordination and understanding of the design as it progresses throughout project stages, through the use of spatial and object-based design models.	Models should be iteratively produced and coordinated amongst other disciplines through collaborative working procedures. Attribute data should be applied to modelled objects through the design development stage to enable asset information to be extracted at the completion of design development.	3D discipline specific models in: • Native file formats. • IFC 2x3 (for spatial coordination). • Other Published review formats as agreed. • Attribute data sets to be provided for extraction and uploading into the departments Information Management Systems.

Table 10.3 – Design / construction review and communication

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To assist project stakeholders in understanding the physical and functional designs in a spatial manner and to manage input and feedback from reviews.	Interoperability between design authoring software and the ability for other stakeholders to reference and interact with discipline specific models should be considered, particularly if software or training is required.	• Federated models in a format that can be easily interfaced with by the appointing party.

Table 10.4 – Design visualisation

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To allow project stakeholders to see and understand design solutions that represents reality so they can work towards improving the building design before construction starts.	Development of 3D federated virtual models to assist decision making and comprehension of the ultimate physical construction with added functionality for virtual fly-throughs and model interrogation.	• Federated models containing all required discipline models that fully represent the final construction.

Table 10.5 – Spatial coordination for clash avoidance / detection

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To provide assurance that the collaborative and iterative design process is generating coordinated design and construction information and is being reported and managed effectively.	The focus should be on clash avoidance through the regular sharing and coordination of 3D models. Sharing of models should occur as and when they are ready and not only as per prior agreed regular intervals. Clash reporting should be used as a way of communicating key coordination issues and tracking the input, review and resolution of any coordination challenges.	• Evidence that the collaborative procedures outlined in the lead appointed party's BEP are being followed consistently. • Availability of a federated 3D attributed model comprising of all relevant discipline models. • A clash detection report made available prior to and leveraged during design and construction review meetings.

Table 10.6 – Design and engineering modelling for functional analysis

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
Leveraging analysis tools and performance simulations to test and significantly improve the design of the infrastructure.	Consider the engineering analysis tools to be used and how evidence and assurances of the virtual tests and simulations can be provided.	• Automate analysis resulting in saved time and cost. • Achieve the optimal design solution. • Improve quality of design through design analysis.

Table 10.7 – Quantity take-off and cost planning

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
Used for quantity take-off to determine material quantities from the design models for inclusion in the estimating process.	Consider cost estimation throughout each project development phase and allow access for financial management tracking against budget allocation.	• Material volume for estimation and scheduling. • Asset quantities for estimation and scheduling. • Exploration of design options. • Provision of cost information at each stage gate. • Ability to stay within budget. • Updated cost materials.

Table 10.8 – 2D drawing production

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To clearly represent the design that is required to be constructed.	The information shown must be adequate for tendering and construction and align with Transport and Main Roads Drafting and Design Presentation Standards Manual.	• 2D drawings shall be derived from 3D attributed models to the fullest extent possible.

Table 10.9 – As Constructed models

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To provide a static dataset reflecting both spatial and attribute data which fully represents what has been installed or constructed.	The precision and tolerances used in capturing or post-producing As Constructed models and data sets should be clearly stated. Consideration of the timing and methodology of how data will be captured is also important and should be included in the BEP. Mark-ups and redlining need to be resolved and used to update any model and attribute data prior to delivery to the appointing party for acceptance.	Model formats for As Constructed models and datasets can include: • 3D attributed information models created from As Constructed survey data capture. • Post-produced surface modelling.

Table 10.10 – 3D model attribution for asset handover

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To provide the necessary data for transferral into Transport and Main Roads systems to support asset maintenance and operations activities.	The attributes must be complete, accurate and consistent with the standards, methods and procedures required by Transport and Main Roads and the project contract. Attributes for handover into operations and maintenance can be both embedded and associated with the 3D models. However, the preference is to have the data associated via the Unique Object Code for each maintainable asset to avoid the risk of duplication and issues with change control of data.	• 3D attributed models with Unique Object Codes as a minimum. • Attributes to be extracted from the models and uploaded into departmental asset information management systems. • Associated attributes for use into operations and maintenance.

Table 10.11 – Construction, operations and maintenance planning and simulation

Intended purpose	Information production considerations	Required output for delivery to Transport and Main Roads
To assist operations and maintenance stakeholders in understanding and influencing the design and construction of assets.	Consider the systems and availability of operations and maintenance stakeholders in capturing their input and feedback on any simulation and how they can leverage the model and attribute information provided by projects beyond handover.	• Discipline and federated models which have been fully coordinated and approved. • Asset data in a format for consumption within the key asset information management systems.