TRANSPORT

Setting Up for BIM

Digital Engineering Framework

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Contents

Introduction

This guide provides a Building Information Modelling (BIM) focused summary of the contractor's considerations during project set-up tasks.

Overview

During project set-up, the contractor must complete the following tasks:

- understanding the BIM requirements
- setting up a Common Data Environment (CDE) (see DMS-SD-125 – *Establishing the Contractor CDE* for details)
- ensuring all project information is structured using the Project Data Building Blocks (PDBB)
- establishing roles and responsibilities
- managing information security
- making decisions on appropriate hardware and software
- planning for production of deliverables
- planning for coordination
- planning for design review

- planning for handover.

The results of these considerations should be included in the project's Digital Engineering Execution Plan (DEXP).

The DEXP Template provided by the TfNSW project team contains guidance for authors (based on DMS-FT-532 – *DEXP Template*). A separate DEXP technical guide summarises its purpose and use (see DMS-SD-149 – *Using the DEXP*).

All templates and guidance documents may be modified by the TfNSW project team to include requirements specific to the project. The contractor must take care to obtain the latest documents from the relevant TfNSW project team (where applicable), rather than apply templates or documents from other projects without asking for project-specific versions.

Building information modelling (BIM) requirements

Deliverables

The contractor may be obliged to provide more deliverables than those listed explicitly in the contract documents, due to requirements set out in DMS-ST-207 – *DE Standard, Part 2: Requirements* and to ensure that the project is successful.

Examples of scope which may be set by the Digital Engineering (DE) Standard but not stated explicitly in the contract documents include:

- model file types
- interim sharing of models for coordination
- clash detection reports and model validation certificates (see DMS-FT-556 – *DE Model Validation Certificate* template).

The contractor is required to outline all planned BIM deliverables in the Master Information Delivery Plan (MIDP) (see DMS-SD-144 – *DE MIDP* Quick Reference Guide for how to do this and DMS-FT-555 – *MIDP Template*), so TfNSW can check that the scope has been understood correctly.

The DMS-SD-140 – *Project Deliverables Requirements Guide* provides a summary of deliverables called for by the DE Standard, along with data requirements for some of the deliverables. Use this guide, along with your contract brief/scope, to help develop your MIDP.

Figure 1 shows an image of BIM deliverables being reviewed.

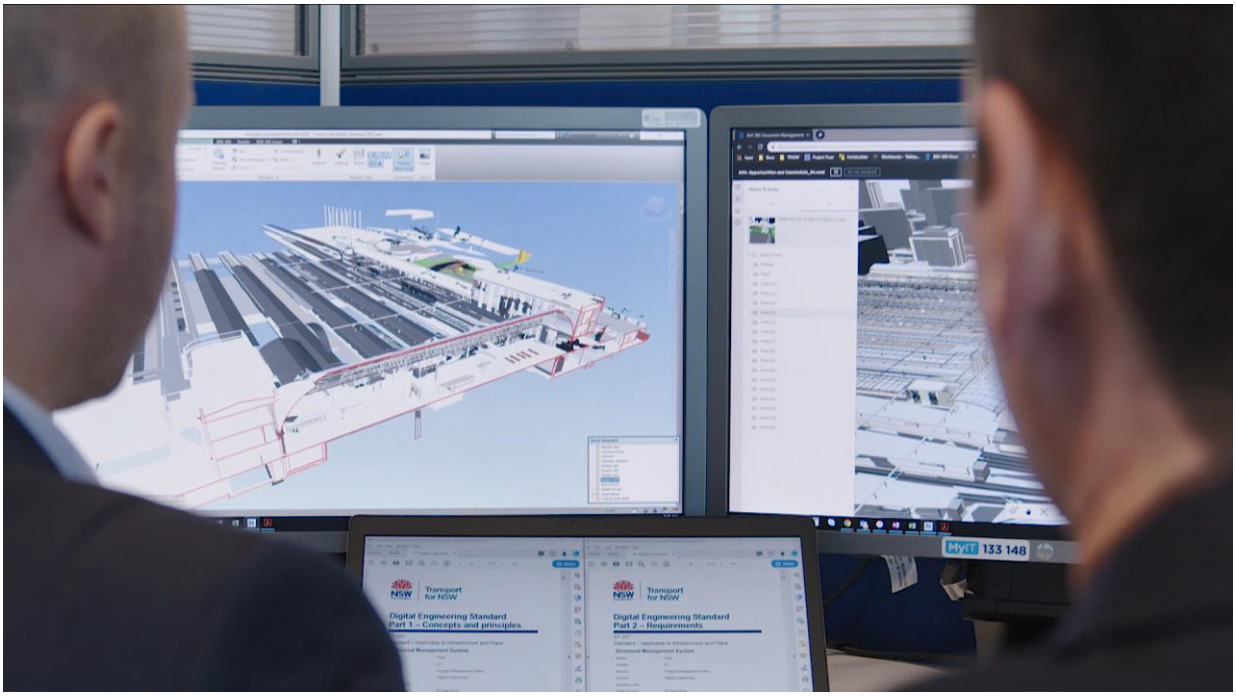

Figure 1 – Reviewing BIM deliverables

Model property requirements

DMS-ST-207 – *DE Standard, Part 2: Requirements* requires that the metadata within model deliverables is standardised according to the PDBB. Models must contain TfNSW and project standard datasets coordinated with the rest of the project, rather than uncoordinated datasets.

The 'model property requirements' table in the DE Standard lists the 'model object' properties which TfNSW mandates. Detailed requirements and datasets for model properties can be found in the DMS-FT-516 – *BIM Schema and Specification*. The requirements of the BIM Schema and Specification are dependent on the project phase.

The project DEXP must clearly articulate any changes to the standard BIM properties provided in DMS-FT-516, including how and when each property must be applied.

File types

DMS-ST-207 – *DE Standard, Part 2: Requirements* requires models to be delivered in various formats to accommodate different downstream uses:

- Individual model files:
    - native models (original file format) – for any future modifications to the assets
    - Navisworks cache files (NWC) or an agreed project alternative – for federation, clash detection and validation
    - Industry Foundation Class (IFC) – for open data sharing and interoperability.

- Federated models:
  - native models federated in a compressed folder where possible
  - Navisworks bound document (NWD) – for review of the federated model
  - IFC – where a project is small enough for efficient federated models in IFC format.

Design coordination

The contract may require that the developing design be shared at regular intervals with TfNSW and/or other parties for coordination and use in working groups. In this case the processes and technology for sharing should be established with TfNSW at the beginning of the project and documented in the project DEXP.

Design review

The models and model exports will be reviewed by TfNSW as part of each formal milestone. BIM metadata will be audited against the Project BIM Schema and Specification (based on DMS-FT-516).

Common Data Environment (CDE)

Overview

DMS-ST-207 – *DE Standard, Part 2: Requirements* requires contractors to have a planned and well-structured environment for managing project information, known as a Common Data Environment (CDE). This term encompasses the various connected IT systems as well as defined collaboration processes which rule how information is managed. ISO 19650-1:2018 summarises the conceptual elements of a CDE. Refer to the DMS-SD-125 – *Establishing the Contractor CDE* technical guide for details.

From a BIM perspective, the benefits of having a CDE include:

- clarity on the status and suitability of models prevents accidental distribution of errors and confusion over the purpose or appropriate use of the information
- processes for model sharing improve the consistency and reliability of delivery
- improved clarity on ownership and responsibility
- consistent metadata enables better automation of repeat processes.

Setting up for BIM in the CDE

Setting up for BIM in a CDE normally involves integration planning for various systems. The following questions should be addressed during planning:

- What is the quality assurance workflow which deliverables pass through:
  - during weekly coordination activities
  - for coordination with external parties
  - for delivery to the TfNSW project team?

- How is work in progress information (which has not been checked and therefore may contain errors) restricted from other disciplines to avoid the proliferation of errors?
- How is information marked as approved and made available for coordination once it has been checked?
- Who has the authority for approval at each step along a quality assurance workflow? And how do team members identify the right approvers?
- How are checked models shared with other teams in such a way that they can be efficiently linked in for clash avoidance and design coordination?
- How is information shared (including with the client and external parties) in such a way that its state and suitability are clearly communicated?
- Does the team manage checking and approval at the model object instance level or for the model as a whole?

There are many ways to apply CDE principles to manage building information modelling and TfNSW does not mandate solutions. For major projects, the contractor is recommended to adopt a collaboration platform capable of managing models' state and suitability status as dynamic metadata (rather than separate folders for work in progress, shared and published information). Tools of this nature are also more likely to be able to incorporate role-based quality assurance workflows, automated revision numbering and other benefits. Figure 2 illustrates a conceptual CDE set-up for BIM.

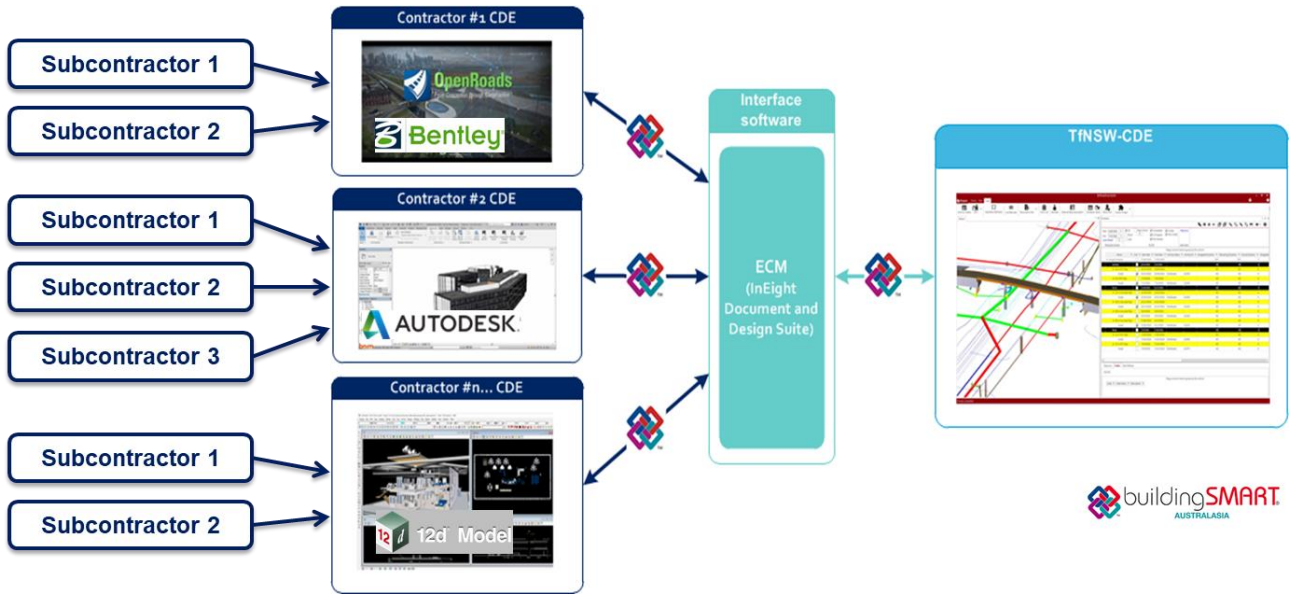

Figure 2 – Conceptual CDE set-up for BIM

Applying the Project Data Schema

It is recommended that the contractor-CDE use the PDBB mandated by the TfNSW project team. These datasets must be built into the modelling and model management tools where possible. Commonly this involves pre-populating the datasets into picklists within the software:

- Model file numbering – make sure models and their exports are numbered according to the Enterprise Content Management (ECM) Schema (see DMS-FT-533 – *ECM Schema Specification*).
- Model properties – make sure the values in the TfNSW model object properties correspond with values from the DMS-FT-516 – *BIM Schema and Specification.*

Roles and responsibilities

Roles and responsibilities which relate to the production, coordination, quality assurance and delivery of digital models are to be detailed in the project DEXP. Accountability and responsibility must be clearly established, including the responsibilities of engineers, architects and other specialists who are responsible for ensuring that the models are an accurate and coordinated representation of the design (or, after construction, of the as-built asset).

If specific roles for digital engineering exists in the TfNSW project team, show diagrammatically how the contractor's team aligns with these positions.

Information security

The digital models used on TfNSW projects may represent sensitive assets or carry other sensitive information. If unprotected the information in this digital form is vulnerable to misuse and as such it poses a threat, which must be managed carefully. Broadly speaking information security in BIM is affected by three factors:

- sensitivity of the assets and information
- security of the project IT systems
- risks in the use policies and processes.

DMS-ST-207 – *DE Standard, Part 2: Requirements* requires the contractor to detail information security measures in the project DEXP (or separately), to provide assurance that TfNSW's information security requirements are understood and measures are in place to protect the project's information. Guidance is provided in the DE Standard.

It may be appropriate to obtain specialist advice for the development of a data security protocol, especially if the contractor will be working with sensitive information.

Hardware and software

Introduction

Building information modelling is more hardware-intensive than many other project functions and may determine the contractor's hardware requirements including graphics processing, memory and network infrastructure.

Model production – tools for specialist staff

Tools for specialist staff involved in model production, manipulation and automation normally require more powerful machines.

When choosing which authoring software to use, consider the following questions:

- Can data be associated to all 3D objects, elements or strings?
- Does the software possess the necessary functions and features needed to produce the deliverables required by TfNSW, including the required model object properties?
- What other file formats can be linked to the software platform?
- What schedule data or other external data sources can be linked to the software platform?
- Is it possible to effectively share models and collaborate with the other contractors during design and construction?
- Can repeat tasks and metadata management be automated?

Coordination, review and comment – tools for all staff

BIM influences the hardware and software requirements for more than just modelling staff. All staff that need to access design and as-built information must be able to view the model for coordination, review, comment and quality assurance.

There are many different applications and methods to use when viewing models. When choosing which viewing software to use, consider the following:

- Can the models be navigated intuitively?
- Does the software allow for mark-ups and comments against modelled elements?
- Can mark-ups and comments be easily exchanged with other project participants? See industry online guidance on BIM Collaboration Format (BCF).
- Is the software able to read all file formats requested by TfNSW?
- Does the software allow for isolation of objects or elements within the model?
- Does the software allow for interrogation model properties?
- Can repeat tasks such as federation and clash detection be automated?

Planning for production

Introduction

To produce consistent models with the required properties, the project DEXP must clearly articulate how the contractor's team must produce and develop the models to complete the contracted scope. This is achieved through using tools such as a Model Production and Delivery Table (MPDT) and appropriate best practice.

Model Production and Delivery Table (MDPT)

A MPDT must be established by the contractor at the beginning of the project to define for the contractor's team how the models will be developed over time. The MPDT achieves the following purposes:

- Lists the model element types (not each instance) which the contractor plans to use.
- Sets out standard element type metadata, for example, applicable Uniclass code or asset tag type-code.
- Proposes the level of definition for each element type for each project stage.
- Clearly allocates design responsibility for each element type to a particular task team or discipline, to avoid some element types being modelled twice and others being missed altogether.

The MPDT should reflect the staged requirements of the DMS-ST-207 – *DE Standard, Part 2: Requirements*, for example to ensure that the minimum asset classification level is applied at each stage. These requirements are summarised in the DMS-SD-140 – *Project Deliverables Requirements Guide*.

A TfNSW template is available (DMS-FT-534 –*MPDT Template*). The MPDT may be further modified by the contractor to define other aspects of model production including floor levels and spaces at the contractor's discretion.

Modelling practice

The contractor should plan for consistency in best practice modelling across task teams by including specific instructions for model production in the project DEXP. Consider including requirements to:

- Model for easier construction sequencing. For example, model columns and walls by level rather than in a single span.
- Model for efficient quantity take-off and cost estimating. For example, using consistent naming and classification of elements.
- Model human space requirements. For example, space around equipment for both operation and maintenance.
- Model for construction tolerances in a consistent manner.
- Apply consistent floor naming, room naming, asset tagging and colour scheme.

- Apply the classification system in a consistent way.
- Export IFC files in a consistent way.
- Work with model families/assemblies in a consistent manner and with a fully classified model in mind. For example, the contractor may plan to use different cable tray families for different types of cable, to be able to distinguish these services effectively.

Model-based decision-making

The contractor should plan to make use of BIM to reduce the number of drawings required to make project decisions. Where a model could be used to inform TfNSW decisions instead of large numbers of drawings, the contractor should propose the model-based review process. BIM may be effectively used to reduce project costs in this way at any stage, from early options assessments to interim reviews in detailed design. Tools should be selected to enable the right level of BIM for each stage.

Drawing production

One core principle of the DE Framework is that drawings should be derived from models wherever reasonably practicable. The contractor should plan BIM software and processes to enable drawing extraction in the most efficient manner, minimising rework in the event of design changes.

The DMS-ST-207 – *DE Standard, Part 2: Requirements* sets requirements for drawing production.

The DMS-FT-562 – *CAD Schema and Specification* gives a more detailed specification of the CAD datasets.

Planning for coordination

At project set-up, the following steps should be defined in the DEXP and implemented to help successful coordination:

- At the start of the project, identify or create a ‘model coordination file’ (or files) which shares coordinates, survey points, key design points, gridlines and any other coordination points.
- Modellers must be instructed to practice clash avoidance from the outset, linking in shared information from other disciplines and coordinating their modelling appropriately.
- A clear process for clash detection should be outlined, including which clashes are run and how clashes are thinned out, grouped, reviewed and closed out.
- Engineers, designers and technical specialists should be briefed on their responsibilities to work with the design and construction models. All project participants engaging with design or as-built information must be trained to interrogate, coordinate, check and approve models.

- Regular coordination meetings are recommended to review the models for coordination, constructability, health and safety, sustainability reviews, value engineering and other benefits.
- Information sharing agreements should be established with other contractors on the project, and these may need to be agreed with the TfNSW project team.

Planning for contract completion and handover

Where the contractor's scope includes handover to the owner/operator/maintainer, the model objects should represent 'maintenance managed items' (MMI). For example, if the operator treats a mechanical instrument panel as a single item for maintenance, then the panel should be a single item in the model and its parts (screen, dials, internals) should not be modelled separately.

Agreement on these model object types should be sought with the operator and maintainer through dialogue. To provide a starting point for this dialogue a non-exhaustive table of typical maintenance managed items is available, the DMS-SD-141 – *Master Classification Library*.

For information on DE Framework

To find out more about the DE Framework, contact **Digital.Engineering@transport.nsw.gov.au.**

