Transport for NSW

Digital Engineering Framework

DMS-ST-208

December 2022

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Table of Contents

Document control

Location	Located on the **Digital Engineering** area on Transport's IP Divisional Management System (DMS). (Link available to TfNSW staff only).
Document owner	Director Digital Twin Integration
Version	4.0
Original version release date	September 2018

Versions

Version	Published date	Summary of changes
1.0	4 September 2018	DE Framework Launch
2.0	8 April 2019	DE Framework update
3.0	30 October 2019	DE Framework update
4.0	December 2022	DE Framework update

1 Context

Transport for New South Wales (TfNSW) is using the Digital Engineering (DE) Framework to enable time, cost and quality improvements to the way that projects are planned, designed, constructed, operated and maintained throughout their life cycle.

The DE Framework is supporting projects being delivered now and is being continually improved for new ways of working and additional scope.

1.1 Purpose

The purpose of this Framework is to provide guidance to Project Management teams and individuals across Infrastructure and Place (IP) on the use of Digital Engineering and the activities required to be undertaken throughout the life cycle of a project to manage a project's digital assets.

1.2 Introduction

For TfNSW, DE is defined as 'a collaborative way of working, using digital processes that enable more productive methods of planning, constructing, operating and maintaining TfNSW's assets.'

The implementation of a DE Framework is in line with the TfNSW *Data and Information Asset Management Policy* (CP17005), which provides the linkage between DE and the Asset Management Framework as applicable to Transport. This policy sets the common understanding (both internally and externally) of the importance of DE and the future direction of TfNSW digital asset management.

The DE processes defined as part of the DE Framework provide TfNSW with an approach that enables digital information to become a key enabler of decision-making, stakeholder engagement, improved asset knowledge, capability and capacity planning.

1.3 Application

The DE Framework has been developed to support IP Major Works and Professional Services Contracts.

2 DE Framework objectives

The DE Framework objectives are based on establishing core digital engineering capabilities within TfNSW, including:

- **Digital Twin –** supports the creation of a 'digital asset' that enables us to visualise and manage critical data to gain new insights.
- **Procurement** – enables improved procurement of DE deliverables through standardised and scalable templates, supported by technical guidance.
- **Ways of working** – improves project outcomes by supporting a step change in adopting the DE Standard and technical guidance to provide better project data and decision support information.
- **Technologies** – provides key support for DE, including using Common Data Environments and the pre-configured Enterprise Content Management platform for

project communications and information exchange. Technology will also enhance mobility and BIM model reviews.

- **Skills and resourcing** – improves skills by creating a consistent understanding and implementation of DE through training, including establishing new skills for project management and design approvals. The DE Framework also provides access to DE expertise through the DE Panel.

It is expected that uses of DE at TfNSW will evolve over time with an increased uptake by projects of DE methods and technology.

3 DE uses

During establishment of each project phase project teams are able to assess the potential uses for DE, including how it can be used to reduce risk, improve collaboration, and enable data re-use.

The following list of DE uses can assist projects to determine the purpose and scope of DE for a project.

Design (3D)

The integration of the design of utilities, services, civil, architectural, structural and mechanical, electrical and plumbing elements of the infrastructure/assets, including the surrounding areas, assisting with system assurance using 3D models.

Coordination

The federation of the 3D models of the different design disciplines at key project milestones (for example, prior to a Design Submission) allows project teams to discover conflicts or inconsistencies before construction starts.

2D drawings

2D drawings can be extracted from the 3D model and the drawings will be up to date, coherent and clash detected.

Visualisation and communication

3D models can be used to communicate design solutions to designers and other stakeholders. For example, it is possible to walk through the model, create animations, and see 3D images or visualisations of what the project deliverables will be.

Analysis

Consistent DE data enables analysis, such as reporting and trending, to be standardised across the business. All data can be easily related and compared to gain new insights.

Decision support

DE provides a platform to investigate different alternatives by comparing various parameters such as functionality, scenarios and costs. This can assist with, for example, options analysis and can support investment decision-making.

Time simulation (4D)

The 3D model can be linked to a schedule and generate time simulations to assist with construction sequencing.

Constructability

3D models can be used for safety planning, for example, to analyse construction site layouts, including understanding the impacts and interactions with plant and the surrounding areas.

Quantity take-off

Quantities can be extracted from 3D models for estimating and tendering, as well as for procurement during the construction phase.

Cost estimating (5D)

The 3D model and 4D data can be linked to provide the planned and actual costs during the project delivery and assist with progress claims.

Quality assurance and compliance

Consistent data enables TfNSW to develop tools to validate data quality in submissions automatically and confirm DE requirements have been met. Models can also be used for fire safety reviews, National Construction Code reviews and/or to check accessibility for maintenance crews.

4 Framework documents

The DE Framework is supported by a suite of documents that have been developed to support the aims of the Transport for NSW *Data and Information Asset Management Policy* (CP17005).

The set of contract documents and templates support setting up the people processes and technology to implement DE on a project, including procurement and management of DE deliverables. The documents include:

- DE Standard
- DE technical guides
- procurement templates
- management plan templates.

The key DE Framework documents also illustrate the legal hierarchy for project teams to follow to engage with suppliers on DE.

Please see Figure 1, illustrating the relationship between the DE Framework and project documents, and Appendix B for the complete suite of documents.

5 Project deliverables

Key project enablers provided by the DE Framework include a:

- DE knowledge base providing access to guidance documentation and DE expertise to assist projects using standardised DE processes
- procedure and tools to assist with the standardisation of the Project Data Building Blocks (PDBB)
- unified TfNSW approach to data classification and referencing
- base set of Project Data Schemas (PDSs) for standardising TfNSW deliverables including documents, engineering, time, cost and asset data
- TfNSW Common Data Environment (CDE) configured to enable DE.

The DE Framework aims to enable and support the delivery of the following outcomes across the project life cycle:

- systems engineering – business and systems requirements specifications.
- surveys – traditional and digital surveys (including 3D laser scanning and Scan-to-BIM)
- CAD (2D and 3D) – 2D and 3D drawing information extracted from 3D models
- BIM (3D models) – 3D object-based modelling of infrastructure and assets
- GIS – integration and alignment of GIS and BIM
- scheduling (4D) – simulation linking project schedules to 3D models
- cost (5D) – simulation linking project cost to 3D models and 4D data
- asset data (6D) – structured asset data for operations and maintenance.

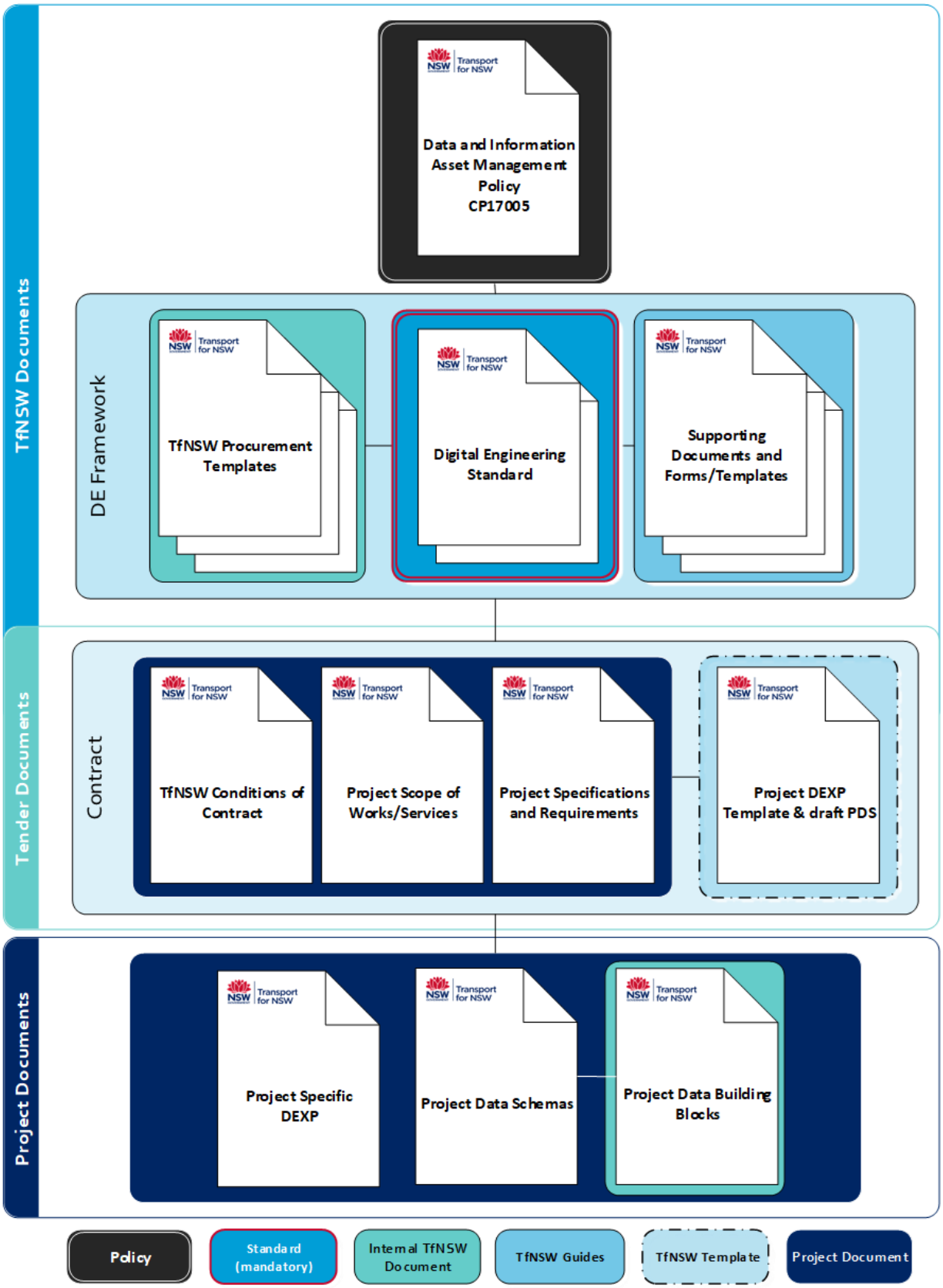


Figure 1 – Digital Engineering Framework document hierarchy as an example

6 Education and training

A series of DE Framework training modules are available to upskill staff working on a project and enable them to effectively utilise the documents and tools available.

Training courses include:

- DE Framework Awareness – covers high-level concepts and project DE objectives
- DE Framework Fundamentals – covers detailed concepts, project implementation and DE deliverables
- DE Framework Specialist – provides targeted training specific to various project roles.

Training is available in the following formats:

- delivered as an intensive course to a project
- team members can register to attend a pre-scheduled training course.

7 Management and technical processes

The DE management and technical process steps required to deliver DE for each project phase are:

1. TfNSW DE preparation
2. Procurement of DE services and deliverables
3. Contractor establishes DE services
4. Contractor designs, develops and delivers
5. TfNSW reviews
6. Contractor reviews and resubmits
7. TfNSW approves.

These steps have been developed to integrate with the existing IP project delivery phases and activities. The steps are shown in Figure 2.

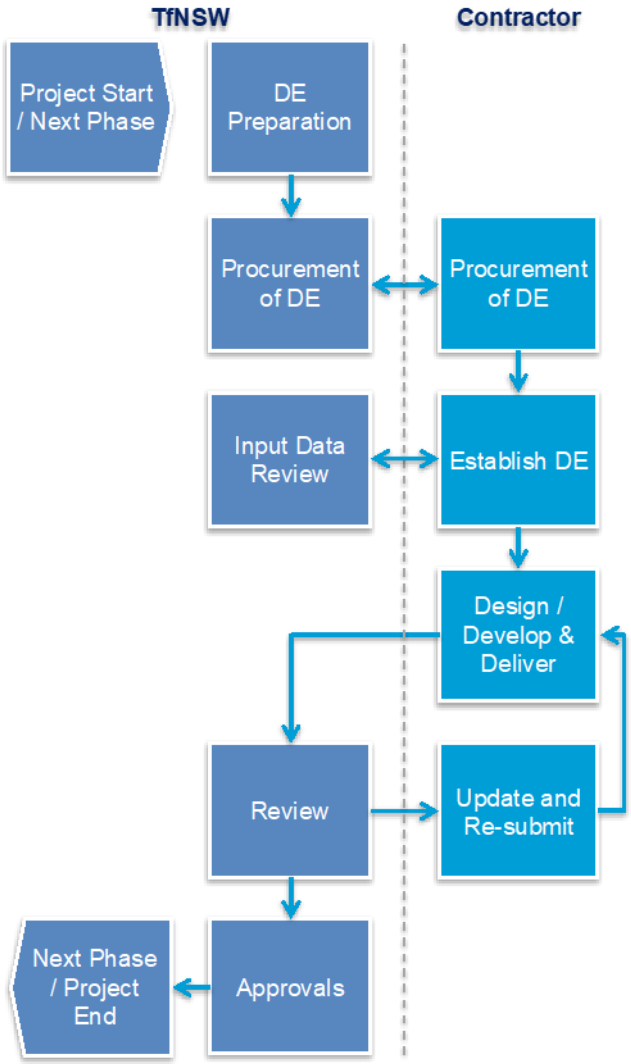


Figure 2 – DE management and technical process steps

Further details on each step are provided in Table 1, including a reference to the relevant DE Framework documents to support the corresponding project DE activities.

A detailed process map covering DE and other project activities for each project phase is provided in Appendix A.

Table 1 – Project DE activities

Process	Description	Document reference
1. TfNSW DE preparation	• Establish human resources, including leveraging support available through the central DE Team and the TfNSW DE Panel for project specific DE expertise. • Define the PDBB and PDS for the project (based on the proposed schemas developed for TfNSW). • Establish the TfNSW CDE including ECM, Scheduling, Accounting, etc. systems. • Develop the DE requirements and Digital Engineering Execution Plan (DEXP) template.	• DE Framework (this document) • updated with DE guidance • PDBB template • PDS templates • DEXP template See Appendix B for document details.

Process	Description	Document reference
2. Procurement of DE	• Develop TfNSW tender documentation using the DE templates available through IP Procurement. • Include standardised DE KPIs to support DE performance management. • Issue tender to the market, including receiving market responses. • Conduct tender evaluation assessing DE components of submissions. • Contract awarded to successful bidder.	• DE Standard • DE Works Brief and Transport Standard Requirement (TSR) • DE PSC Brief and TSR • DEXP template (including TfNSW Project Data Schemas) See Appendix B for document details.
3. Contractor establishes DE services	• Contractor establishes DE resources. • Define and agree the PDS (based on the TfNSW schemas provided). • Establish the Contractor CDE. • Develop the DEXP and submit to TfNSW for approval.	• DE Standard • DE Technical Guides See Appendix B for document details.
4. Contractor designs, develops and delivers	For each of the respective project disciplines: • Receive and validate data (geometrical and non-geometrical) from previous project phase. • Develop project deliverables. • Validate project deliverables against agreed PDS prior to submission. • Submit deliverables to TfNSW for review.	• DE Standard • DE Technical Guides See Appendix B for document details.
5. TfNSW review	• Review the submitted deliverables against the PDS and Asset Standards. • Conduct Industry Foundation Classes (IFC) 3D Model reviews. • Assess compliance with configuration management requirements and design functionality (BAU process). • Review DE deliverables, including design (3D model), scheduling (4D), cost estimating (5D) and asset information (6D) submissions. • Issue comments to Contractor for rectification or approve to submit for Configuration Management and Investment Assurance (IA) gate reviews.	• DE Technical Guides See Appendix B for document details.
6. Contractor addresses comments and resubmits	• Receive feedback (comments) from TfNSW on submissions requesting changes. • Contractor updates project deliverables and resubmits for review (go to design, develop and deliver step).	• DE Standard See Appendix B for details.

Process	Description	Document reference
7. TfNSW approvals	• Project DE team members provide support to IP Configuration Change Board (CCB) and IA gate reviews. • Following approvals to proceed to the next project phases, go to TfNSW DE Preparation step. • If it is the end of the project life cycle, facilitate the transfer of project information to the O&M phase of the asset life cycle.	• Configuration Management Framework

A list of the DE Framework documents is provided in Appendix B.

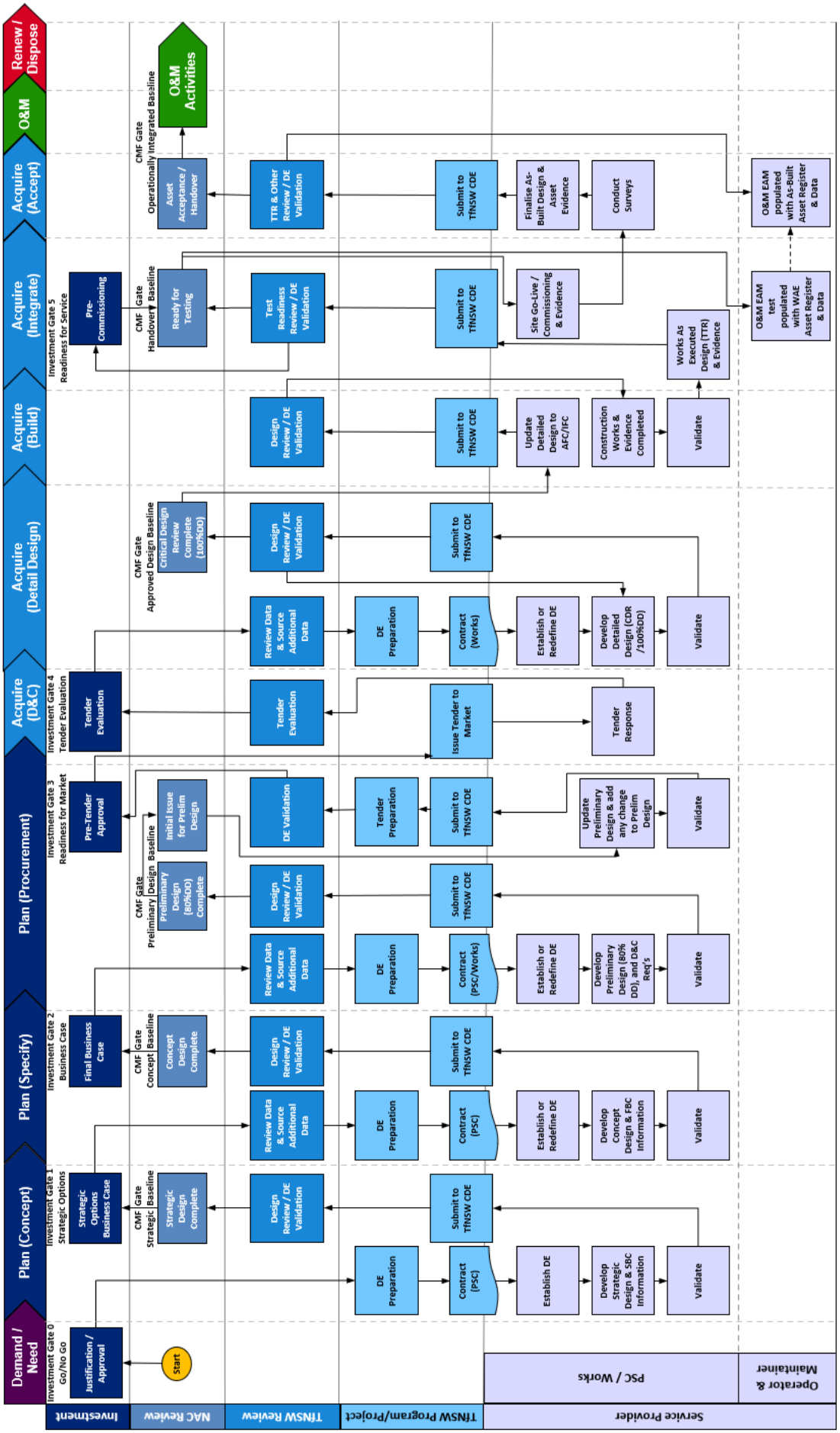
8 Further support, guidance or feedback

For general enquiries and assistance with application of the DE Framework and associated guidelines, education, training, or planning and commencing a digital engineering enabled project, please contact the Digital Engineering Team at **Digital.Engineering@transport.nsw.gov.au**.

The DE Framework embraces a culture of continuous improvement. Suggestions, comments and feedback are welcomed and encouraged.

For general information refer to the **TfNSW Digital Engineering website**.

Appendix A DE process map



Appendix B DE documents

B.1 DE Framework project delivery documents

DE discipline	Document no.	Title	Availability
All	DMS-ST-208	Digital Engineering Framework	Public
All	DMS-ST-202	Digital Engineering Standard – Part 1, Concepts and principles	Public
All	DMS-ST-207	Digital Engineering Standard – Part 2, Requirements	Public
All	DMS-SD-123	Terms and definitions	Public
Information Management	DMS-FT-533	Enterprise Content Management (ECM) Schema and Specification	Public
Systems Engineering	DMS-FT-563	Requirements Schema and Specification	Public
Survey	DMS-FT-493	Utility Schema and Specification	Public
CAD	DMS-FT-562	CAD Schema and Specification	Public
BIM Models	DMS-FT-516	BIM Schema and Specification	Public
Time	DMS-FT-520	Scheduling Schema	Public
GIS	DMS-FT-580	GIS Schema	Public

B.2 DE Framework delivery tools and templates

DE discipline	Document no.	Title	Availability
DE Management	DMS-FT-548	Project Data Building Blocks (PDBB) Template	DE Projects
DE Management	DMS-FT-532	Digital Engineering Execution Plan (DEXP) Template	Public
DE Management	DMS-FT-443	DE Responsibility Matrix	Public
DE Management	DMS-FT-374	DE Code Request Form	DE Projects
Information Management	DMS-FT-555	Master Information Delivery Plan (MIDP) Template	Public
CAD	DMS-FT-549	Digital Engineering CAD Title Block Standard Format	Public
BIM Models	DMS-FT-454	Model Property Check Template	Public
BIM Models	DMS-FT-534	Model Production and Delivery Table (MPDT) Template	Public
BIM Models	DMS-FT-556	Model Validation Certificate	Public
Asset Data	DMS-FT-537	DE Asset Register Template	Public
GIS	DMS-FT-581	GIS Management Plan Template	Public
Survey	IP-0043-GD01	Survey Schema and Specification	Public
GIS	IP-0048-TL01	Template file structure for Aboriginal Heritage Assessments GIS	Public

DE discipline	Document no.	Title	Availability
GIS	IP-0048-TL02	Template file structure for Biodiversity Assessments GIS	Public
GIS	IP-0048-TL03	Template file structure for GIS	Public
GIS	IP-0048-TL04	GIS validation certificate	Public

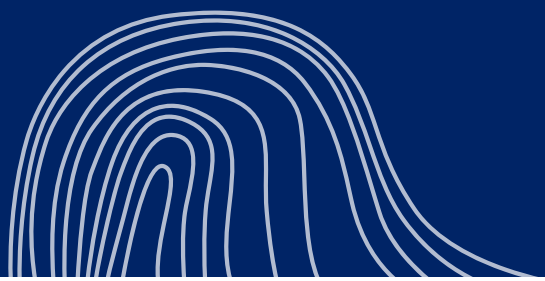
B.3 DE Framework technical guidance

DE discipline	Document no.	Title	Availability
All	DMS-SD-092	Guide to procuring non-standard hardware	TfNSW only
DE Management	DMS-SD-124	Application of Uniclass for Transport for NSW	Public
DE Management	DMS-SD-145	Project Data Building Blocks Guide	DE Projects
DE Management	DMS-SD-143	Project Data Schemas Guide	DE Projects
DE Management	DMS-SD-149	Using the DEXP	Public
DE Management	DMS-SD-140	Project Deliverables Requirements Guide	Public
DE Management	DMS-SD-125	Establishing the Contractor Common Data Environment	Public
Information Management	DMS-SD-128	Procurement of InEight Document Suite	TfNSW only
Information Management	DMS-SD-126	Using the new TfNSW InEight Document Suite	DE Projects
Information Management	DMS-SD-144	The Master Information Delivery Plan (MIDP) Guide	Public
Survey	DMS-SD-142	Digital Survey Requirements Guide	DE Projects
CAD	DMS-SD-139	The Digital Engineering CAD Concession	Public
BIM Models	DMS-SD-136	Setting up for BIM	Public
BIM Models	DMS-SD-137	DE Design Review	DE Projects
BIM Models	DMS-SD-129	Procurement of a Model Review Tool	TfNSW only
Visualisation	DMS-SD-130	Visualisation Requirements Guide	DE Projects
Asset Data	DMS-SD-141	Master Classification Library	Public
Asset Data	DMS-SD-138	Why not COBie	Public
GIS	IP-0048-SP01	Aboriginal Heritage Assessments GIS Specification	Public
All	DMS-SD-092	Guide to procuring non-standard hardware	TfNSW only

B.4 Links

External release documents are available on the **TfNSW Digital Engineering website**.

Internal release documents are available on the **Digital Engineering** area on Transport's IP Divisional Management System (DMS), now replaced by IP Information Management System (IMS). (Link is available to TfNSW staff only.)



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