



# Digital Engineering Framework Program

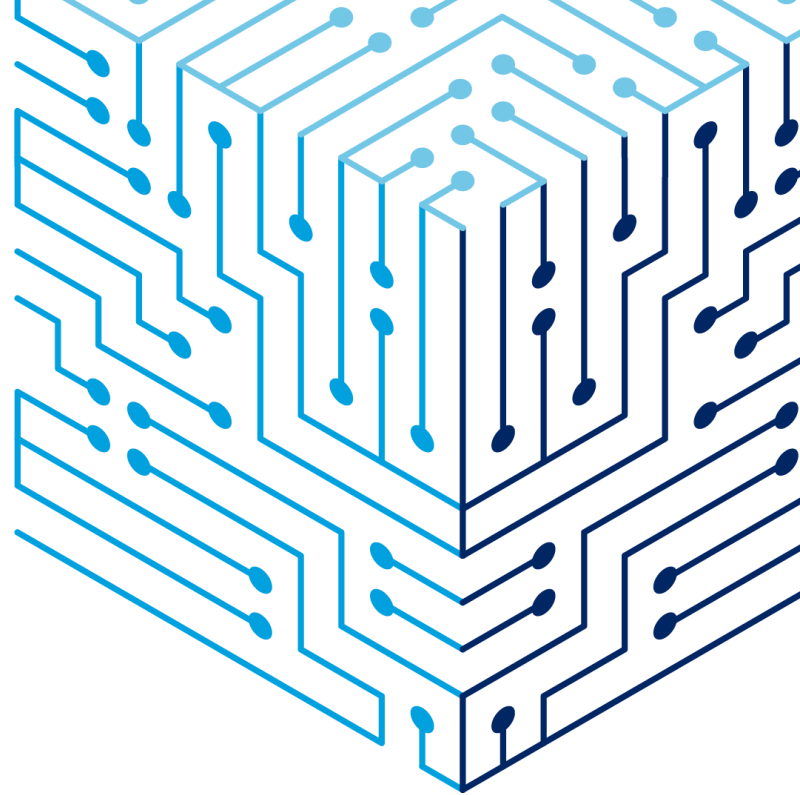
Interim Approach

**Simon Vaux**

Director Digital Engineering  
26<sup>th</sup> September 2018

**Adam Griffiths**

Program Manager Digital Engineering



# Agenda

## Part 1 – Introduction

1. What is Digital Engineering?
2. The TfNSW strategy
3. DE Framework
4. DE Panel
5. Next Steps

## Part 2 – Deep Dive

1. Principles of DE Framework
2. Core enablers
3. DE Framework Documents
4. Training modules
5. How to get started?
6. Q & A

Minister for Transport  
and Infrastructure

Minister for Roads,  
Maritime and Freight

Minister for  
WestConnex

## TRANSPORT FOR NSW

Secretary

Office of the  
Secretary

### DIVISIONS

Freight,  
Strategy  
and Planning

Customer  
Services

Infrastructure  
and Services

Finance  
and Investment

People and  
Corporate  
Services

Transport  
Coordination

### OPERATING AGENCIES

Roads and Maritime  
Services

State Transit  
Authority

NSW Trains

Sydney Trains

Sydney Metro

### KEY PRIVATE ENTITIES

Sydney Ferry  
Operators

Private Bus  
Operators

Light Rail  
Operators

Infrastructure  
Deliverers

# Virtual Construction

## Sydney Metro – Central Stn

Laing O'Rourke



2014

2015

2016

2017

2018





# Options Study Wynyard Precinct Urban Circus



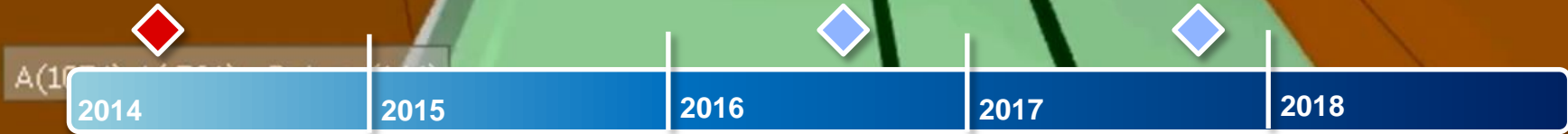
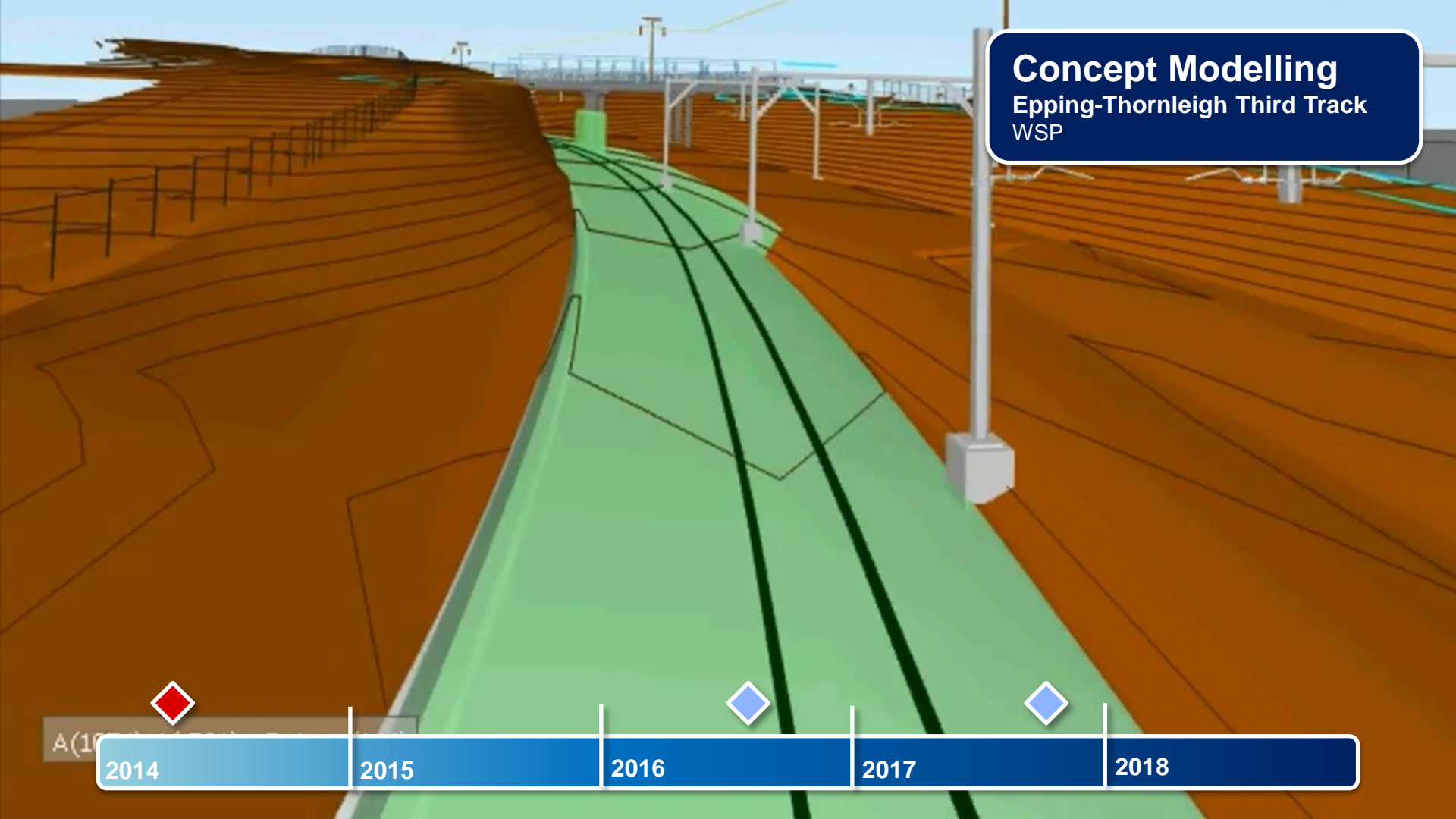
2014	2015	2016	2017	2018
------	------	------	------	------



# Concept Modelling

## Epping-Thornleigh Third Track

WSP



# Model Development Hornsby Junction KBR

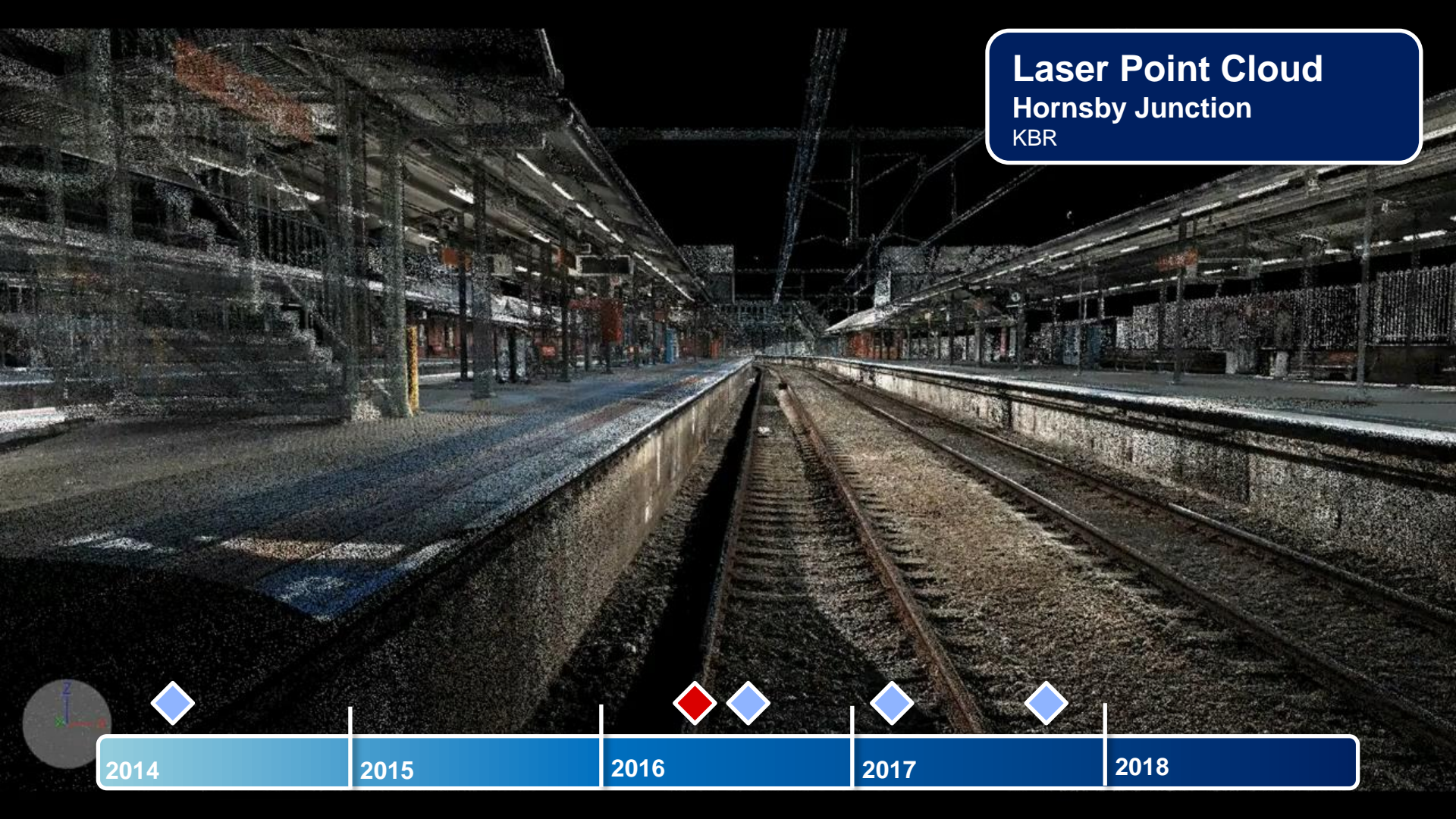




# Laser Point Cloud

## Hornsby Junction

KBR



2014

2015



2016



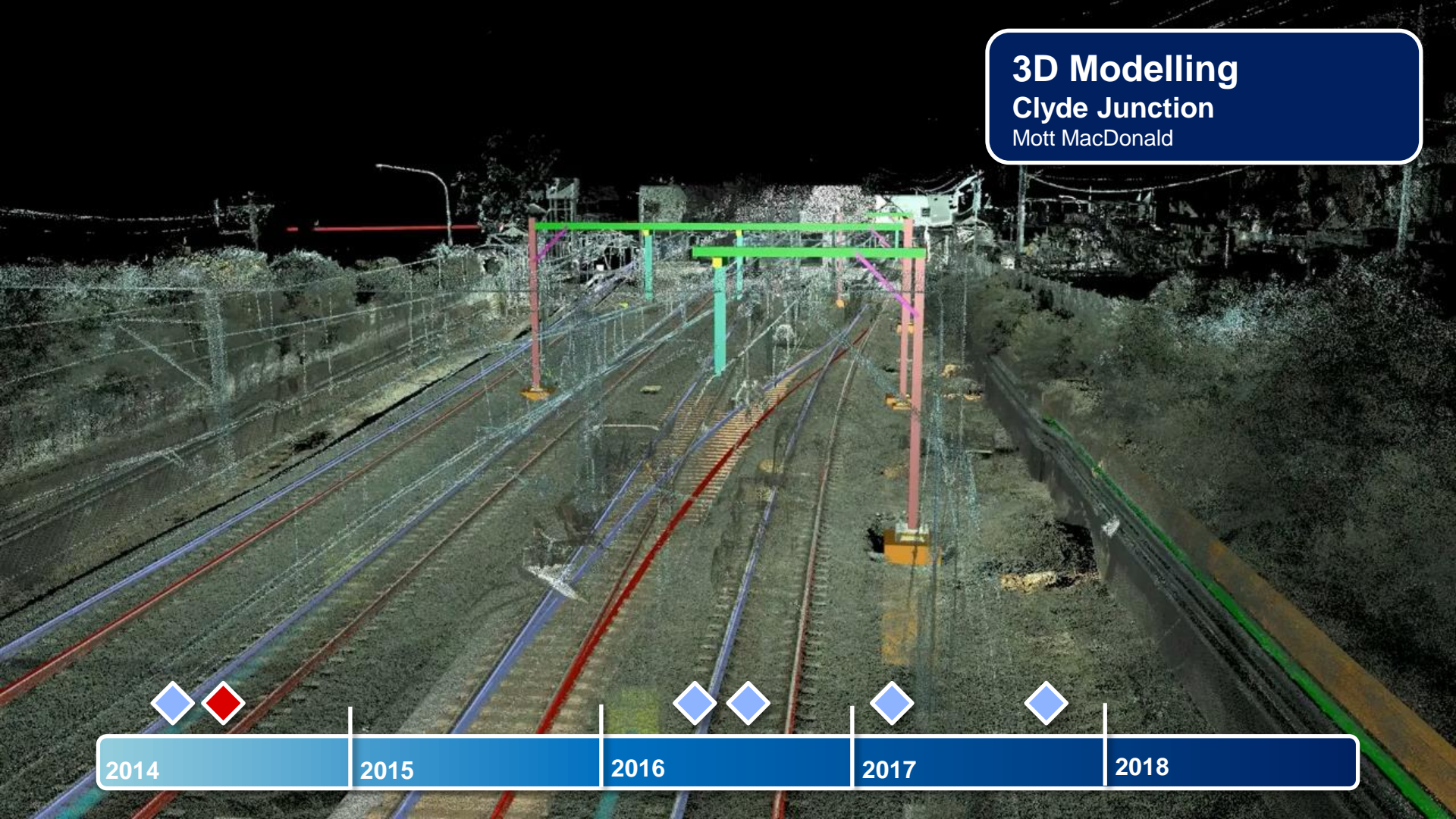
2017



2018



# 3D Modelling Clyde Junction Mott MacDonald



2014

2015

2016

2017

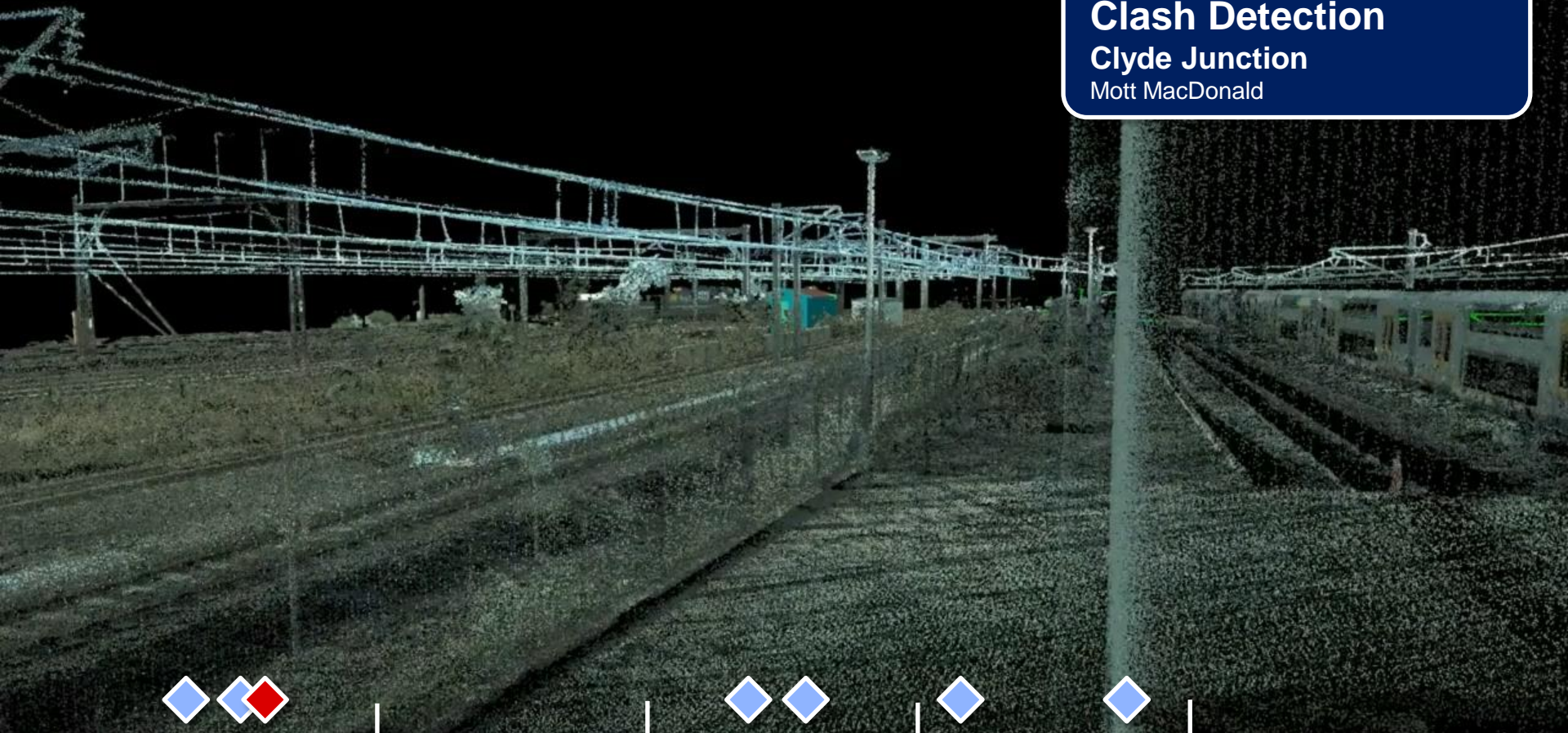
2018



# Clash Detection

## Clyde Junction

Mott MacDonald





# Model Development Hornsby Junction KBR



NSW GOVERNMENT Transport

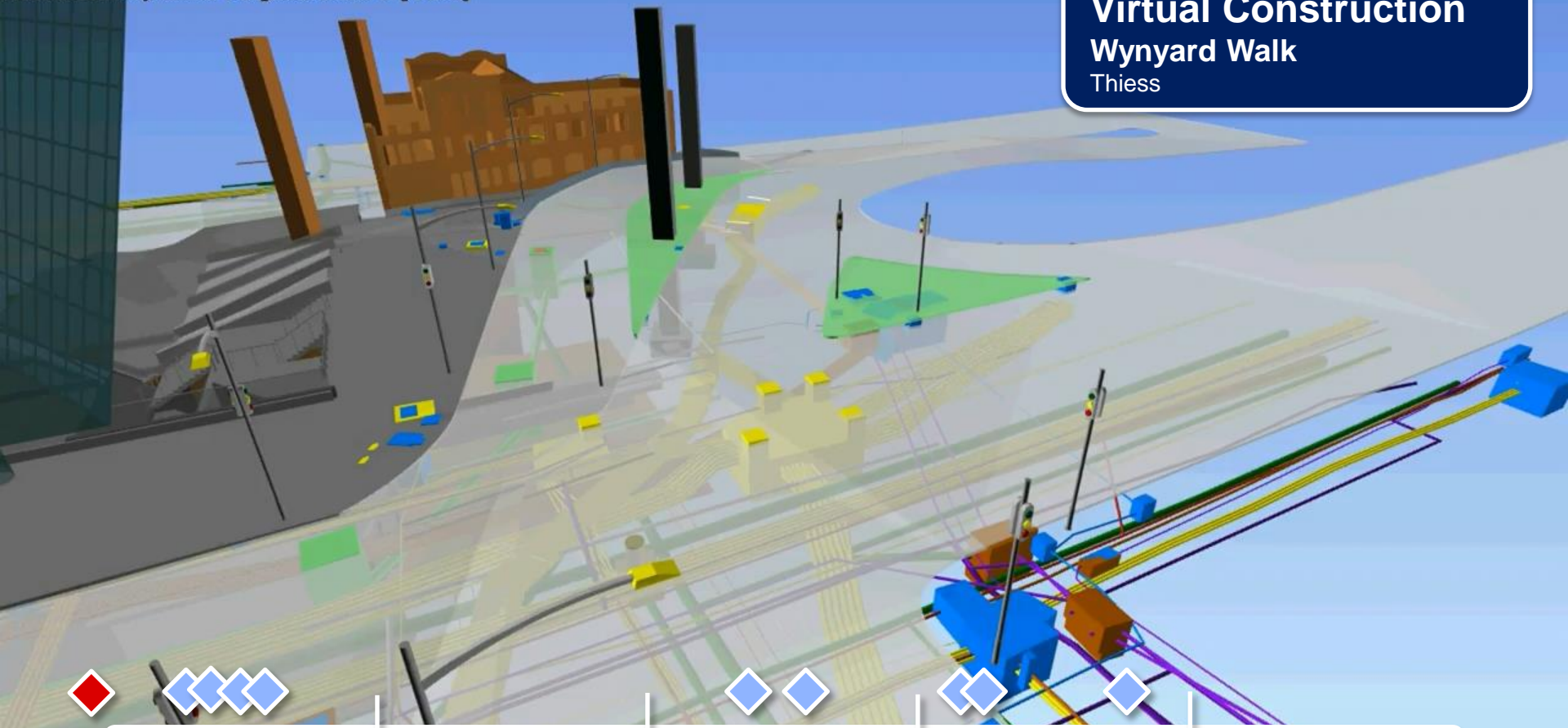


# Utilities Investigation Sydney Light Rail Laing O'Rourke





**Virtual Construction**  
**Wynyard Walk**  
Thiess

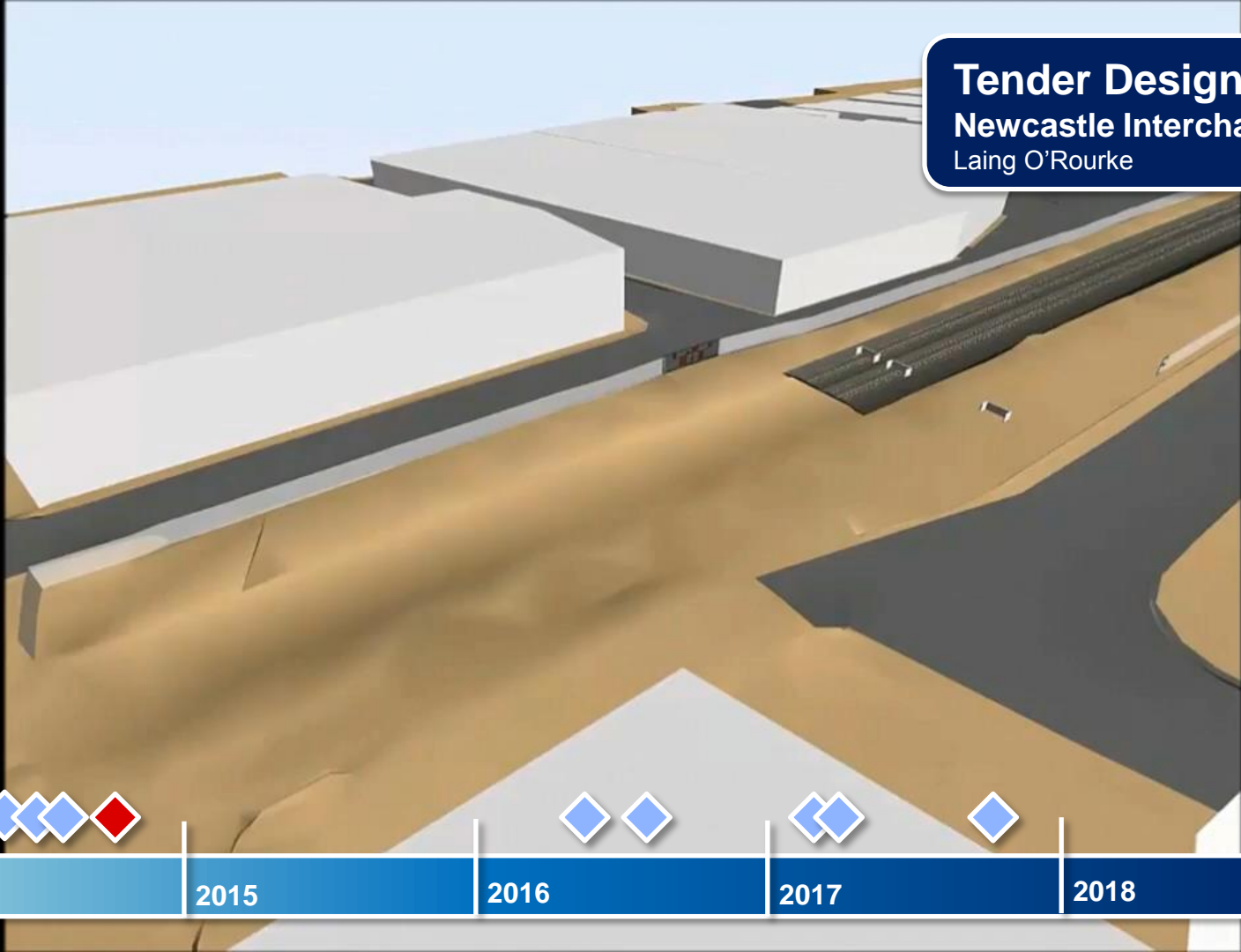


2014	2015	2016	2017	2018
------	------	------	------	------

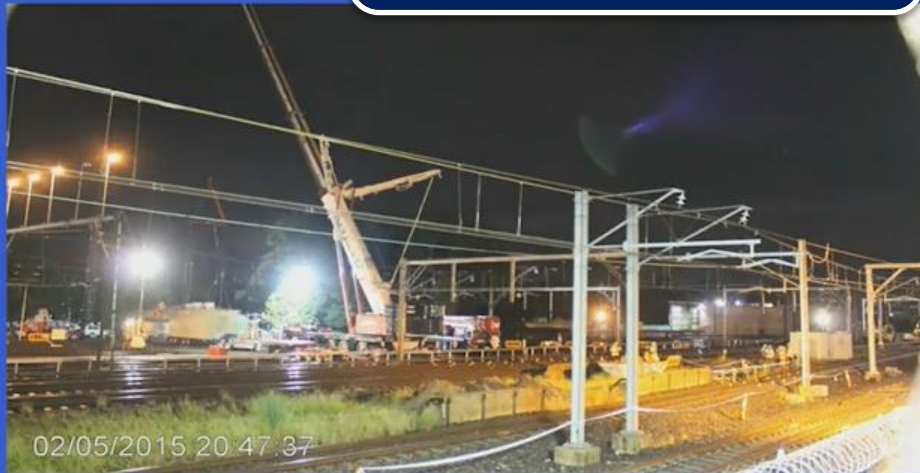
# Tender Design

## Newcastle Interchange

Laing O'Rourke



# Construction Modelling Clyde Junction Mott MacDonald



2014

2015

2016

2017

2018



# Kinematic Analysis

## B-Line

Real Serious Games

NEUTRAL BAY



2014



2015



2016



2017



2018

▼ SPIT JUNCTION

# Traffic Analysis

B-Line

Real Serious Games

WATERS RD

RANGERS RD

WYCOMB



2014

2015

2016

2017

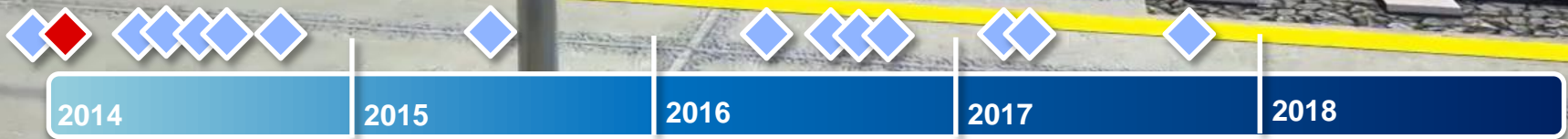
2018



# Human Factors

## South-West Rail Link

Urban Circus



MENU

[ESCAPE]

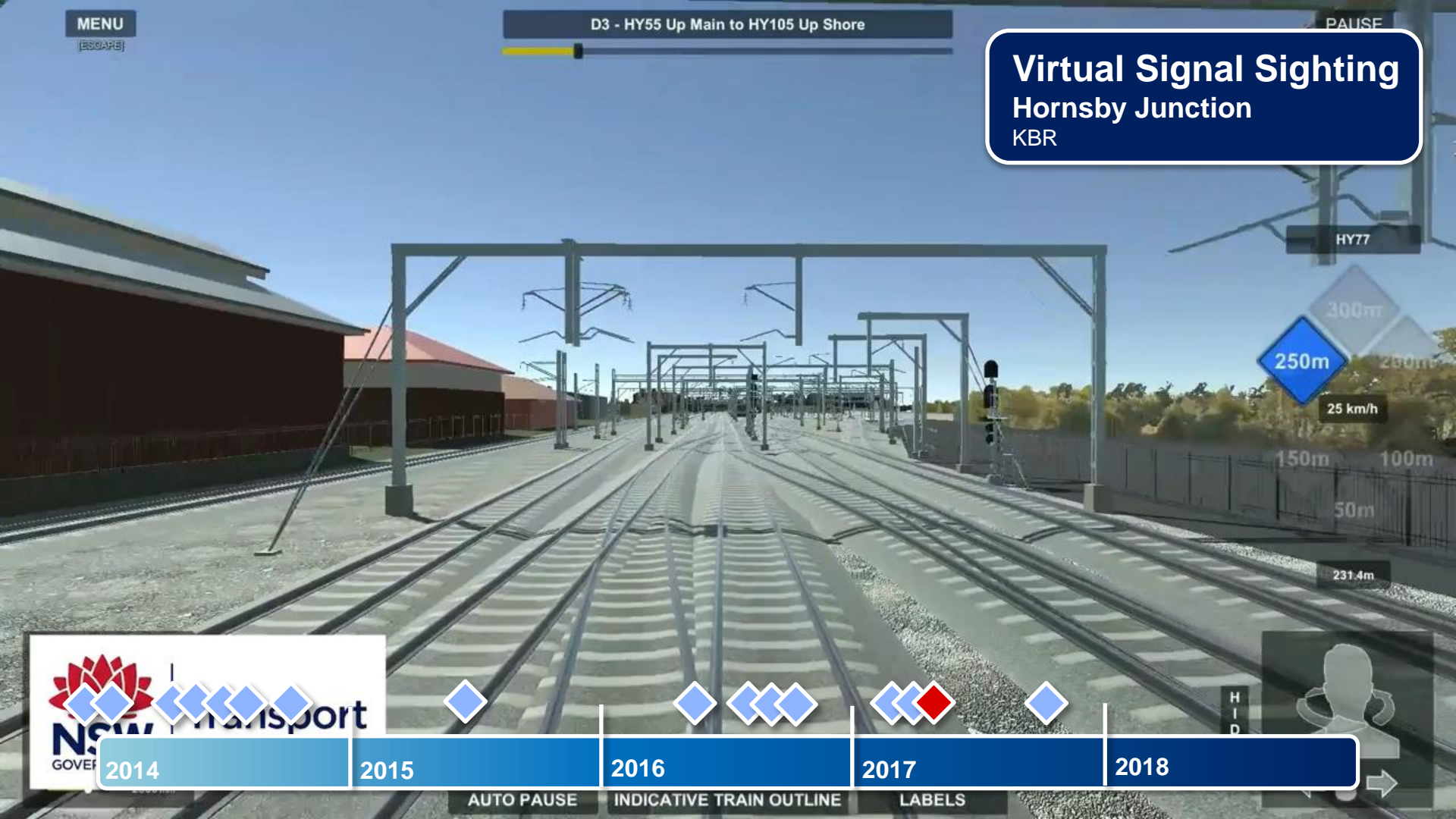
D3 - HY55 Up Main to HY105 Up Shore

PAUSE

# Virtual Signal Sighting

## Hornsby Junction

KBR



HY77

300m

250m

25 km/h

150m

100m

50m

231.4m



2014

2015

2016

2017

2018

AUTO PAUSE

INDICATIVE TRAIN OUTLINE

LABELS

HID





# Virtual Reality Hornsby Junction KBR



WS Wipers

Pause

FUEL MANAGEMENT

Fuel Level Data	GPS Data
F.PRM 35.0 m	Way Point:
F.Aux 15.0 m	
N/A 0.0 m	
Total 50.0 m	Track

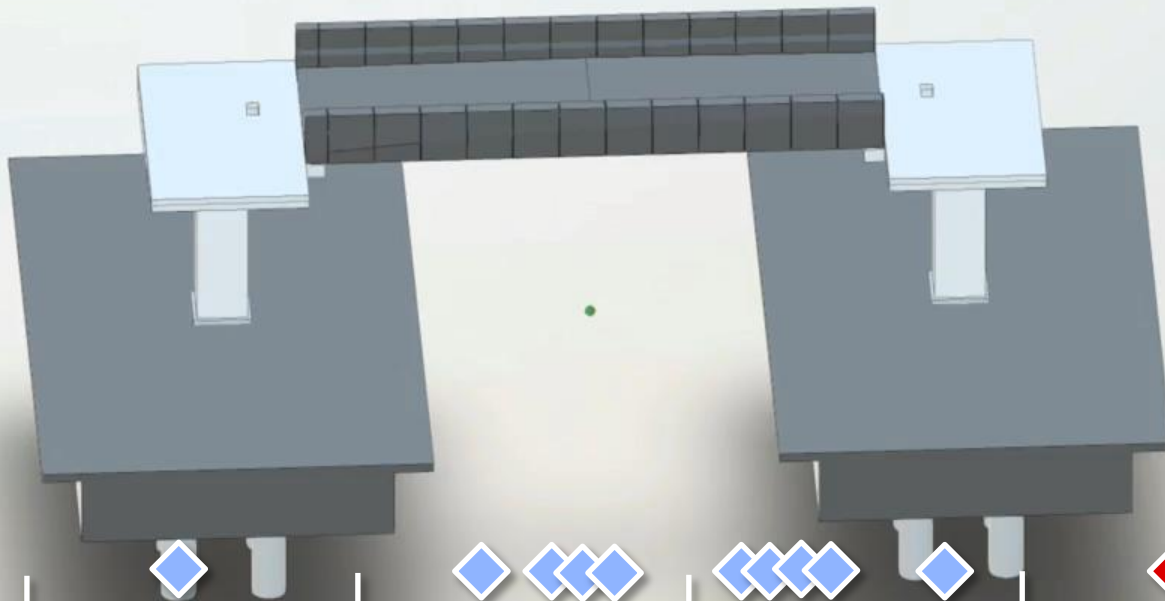
M.P. RPM

F.FLOW 11.5





# Standard Designs Transport Access Program



2014

2015

2016

2017

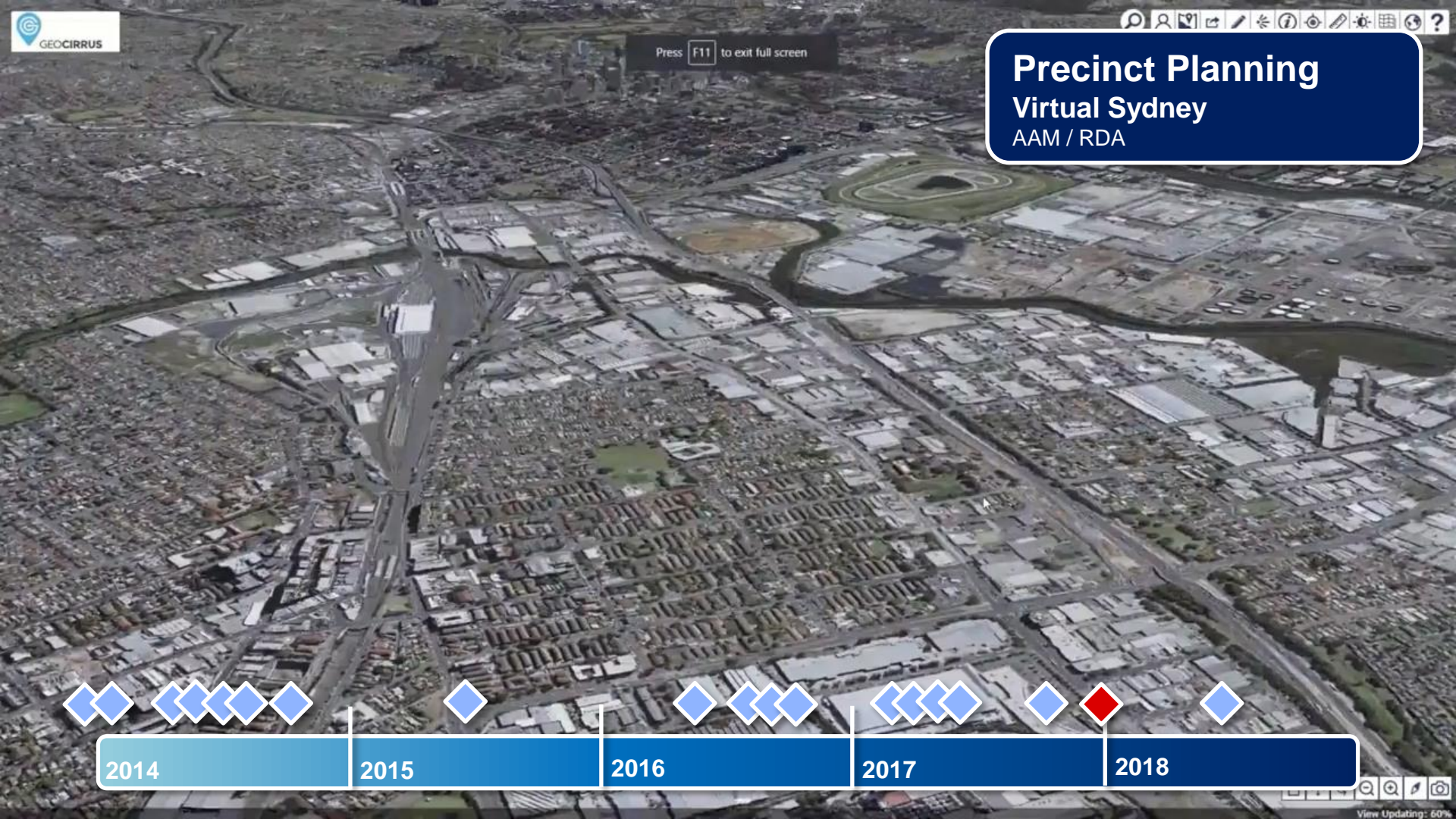
2018

Press **F11** to exit full screen

# Precinct Planning

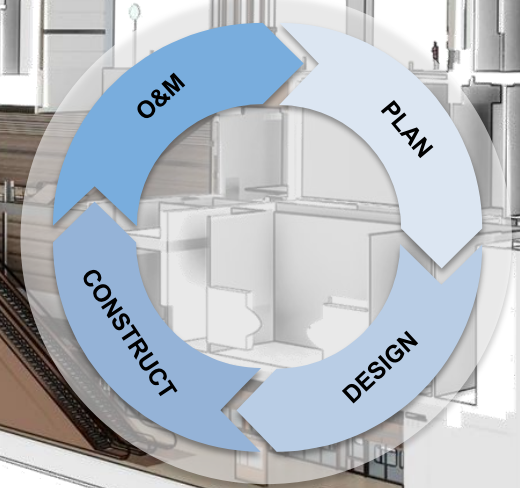
## Virtual Sydney

AAM / RDA



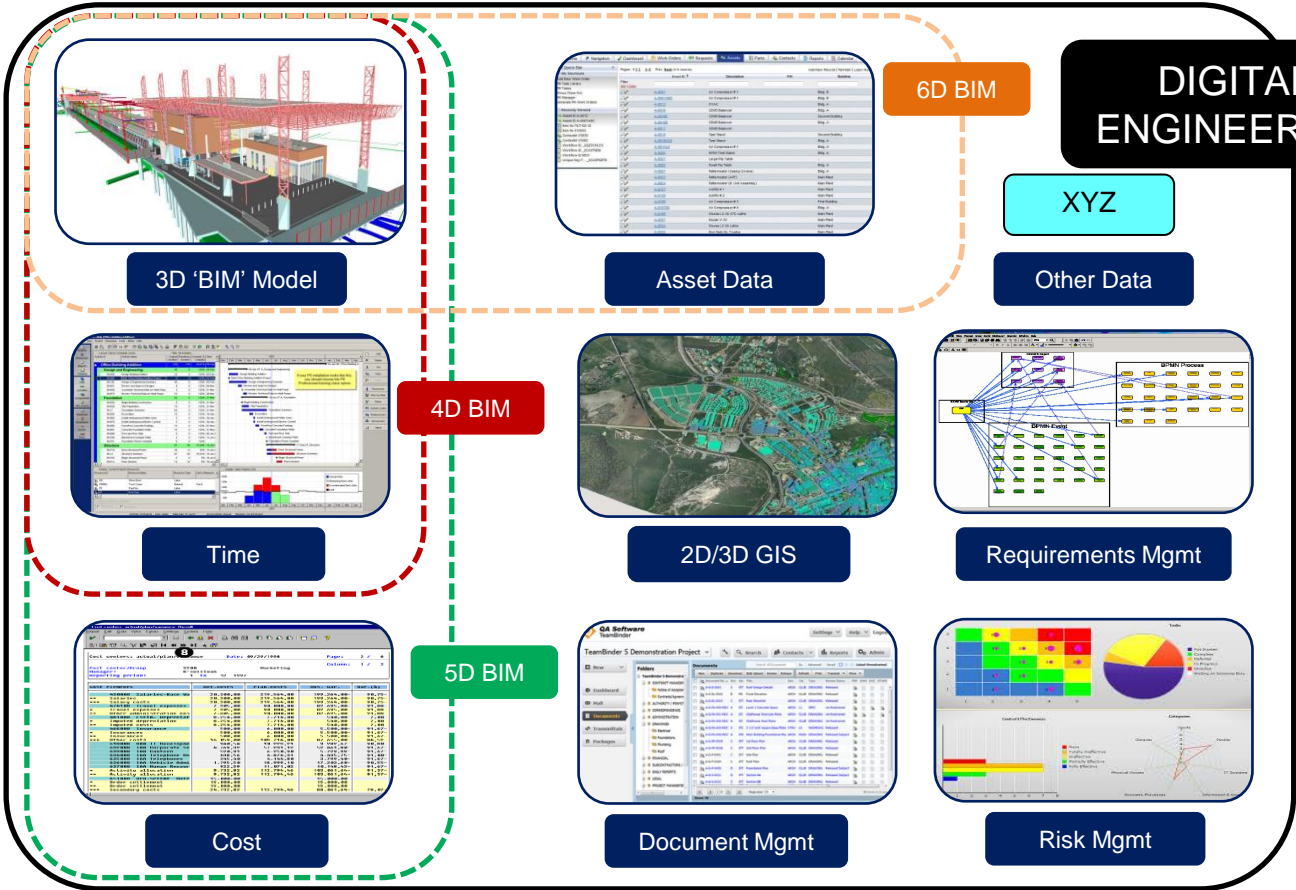
# What is Digital Engineering?

**Digital Engineering** is a collaborative way of working using digital processes, to enable more productive methods of planning, designing, constructing, operating and maintaining our assets.





# DIGITAL ENGINEERING



# Project team benefits

DESIGN



- Improved quality
- More coordinated design
- Faster reviews/approvals

Design Manager



- Reliable benchmark data
- Automated quantities
- Improved estimates

Cost Estimator



- Improved documentation
- Less administration
- Smoother handover process

Document Controller

CONSTRUCTION



- Faster delivery
- Reduced cost
- Reduced risk

Project Manager



- Safety-in-design
- Safer work practices
- Improved site inductions

Safety Manager



- Improved accuracy
- Rapid optioneering
- Optimised schedule

Scheduler

COMMERCIAL



- Less variations
- Early warning of issues
- Traceability of decisions

Commercial Manager



- Less tender queries
- Improved tender submissions
- Faster tendering process

Procurement Manager

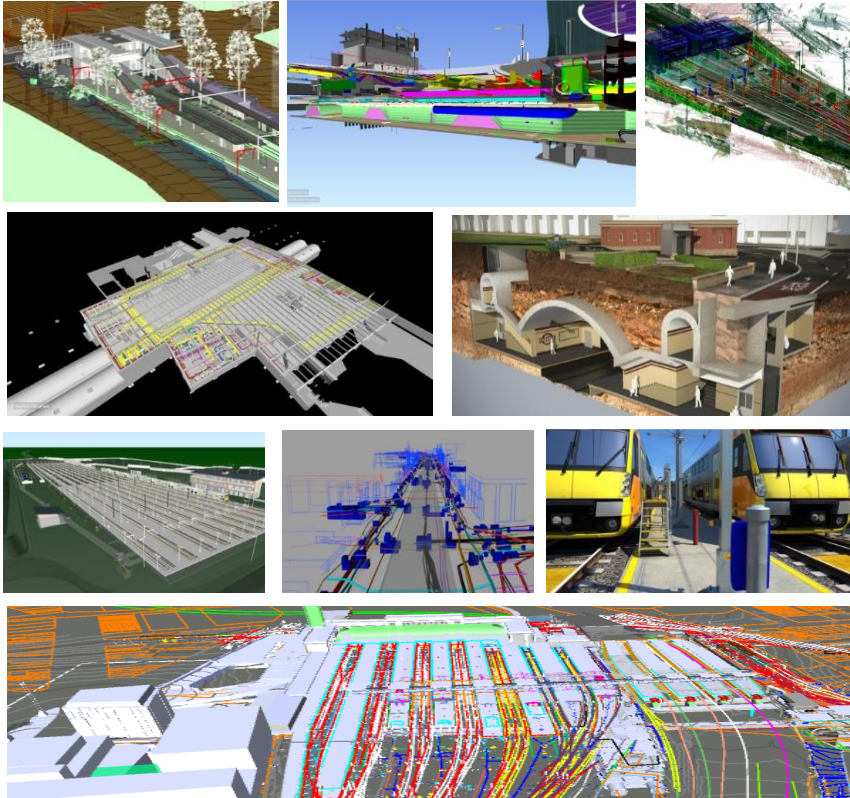
OPERATIONS



- Faster commissioning
- Better information
- Information mobility
- Optimised maintenance

Asset Manager

# Current State



1

DE is rapidly becoming BAU on major infrastructure projects

2

DE techniques being adopted at **all stages of project lifecycle**

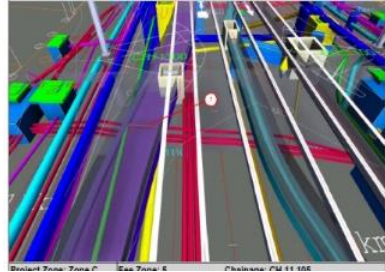
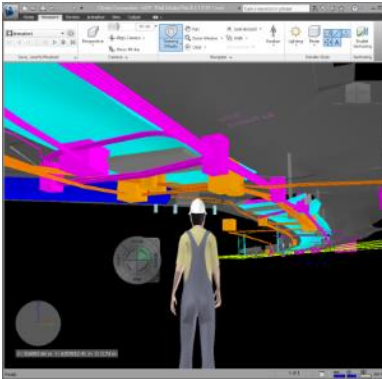
3

DE techniques being adopted on **all types of contracts**

4

DE is frequently being adopted **outside client contractual requirements**

# Current State



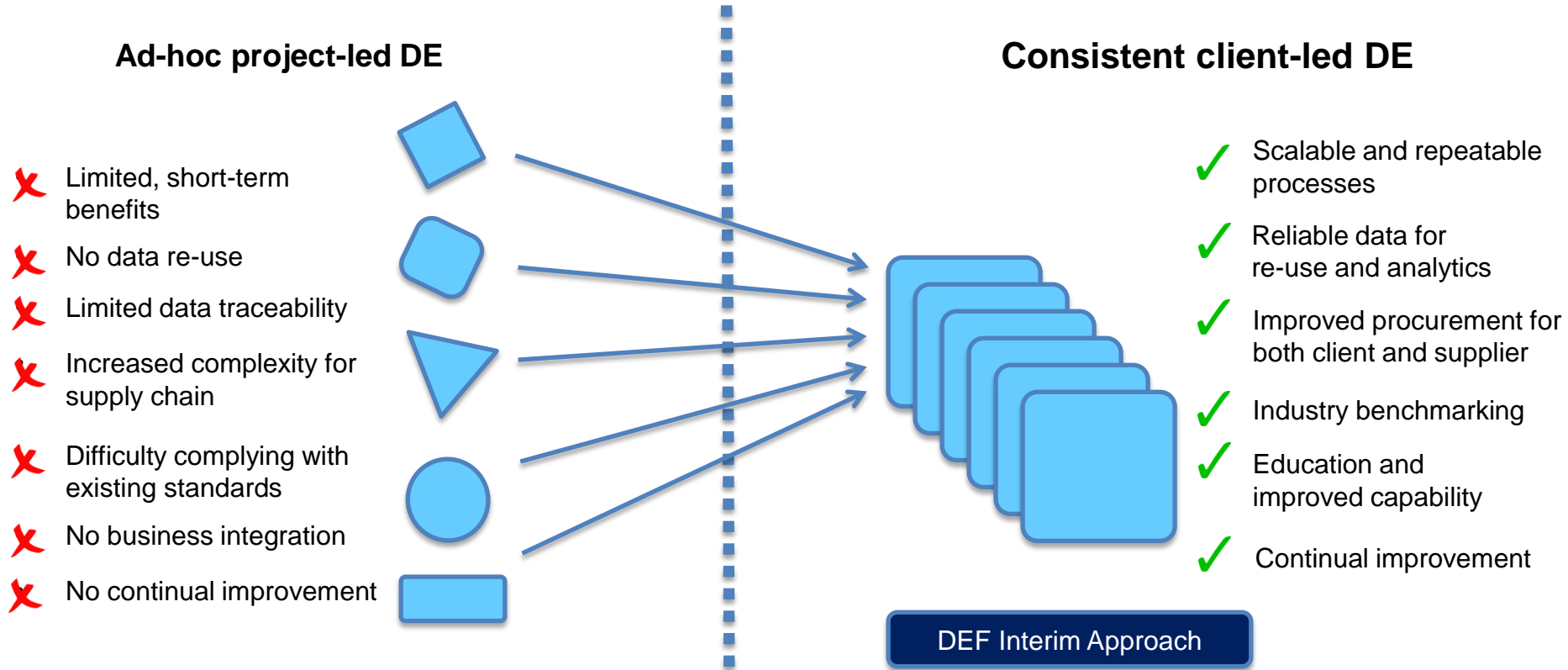
5

DE is commonly used to support single phases of the lifecycle only, **with limited re-use of data or information**

6

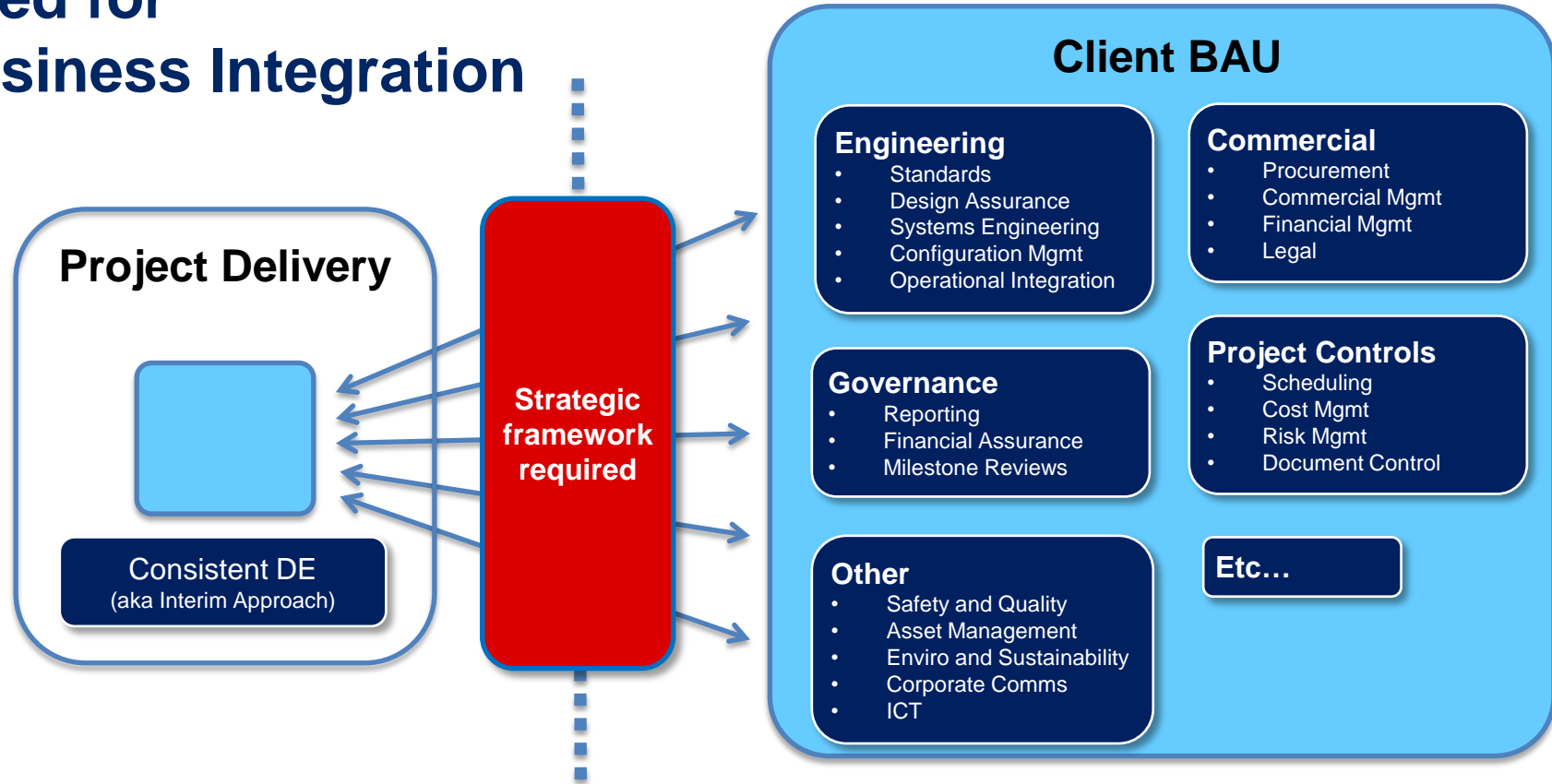
**Greater client maturity is essential for re-use of DE across full asset lifecycle**

# Need for Consistent DE





# Need for Business Integration



# Transport Data & Information Asset Management Policy

Transport will ensure data and information is managed as an asset

This will enable better planning, delivery and management of a safe, sustainable and integrated transport system, by providing **the right data and information, at the right time, to make more informed decisions**

Single source

Collaboration

Automation

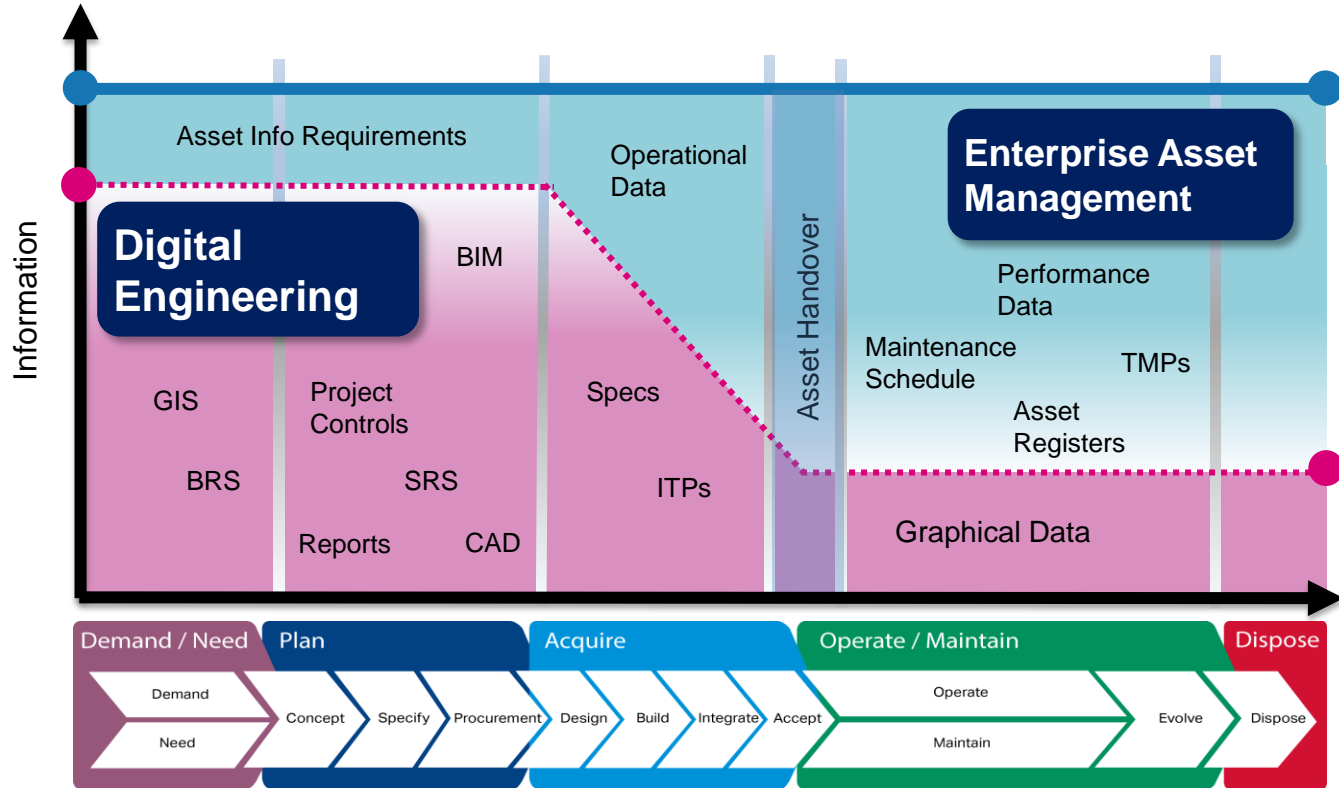
Interoperability

Mobility

Visualisation

Data governance

# Digital Asset Lifecycle



# Digital Engineering Framework (DEF) Program



3D Visuals



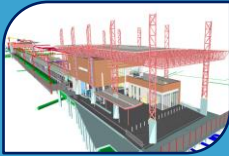
2D/3D GIS



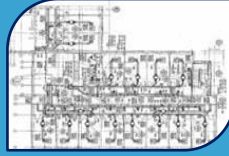
Asset Data Handover



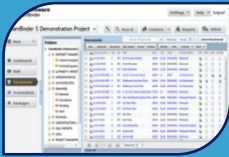
Digital Survey



3D 'BIM' Model



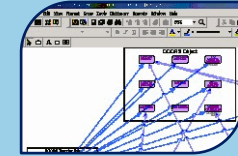
CAD Drawings



Doc Mgmt



Time



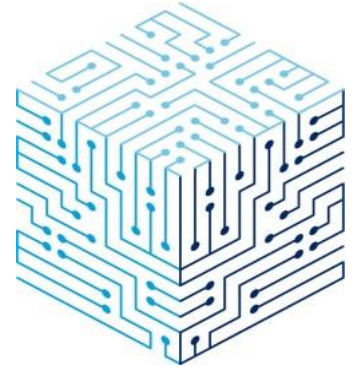
Systems Eng



Cost

DEF RELEASE 1

DEF RELEASE 2



API links

EAM integration

Cluster wide implementation

FUTURE STATE

BAU

# DE Framework Objectives



## Digital Engineering Framework Interim Approach



1. Digital Twin



2. Procurement



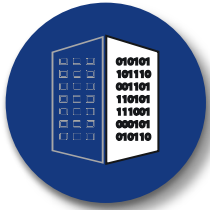
3. Ways of Working



4. Technologies



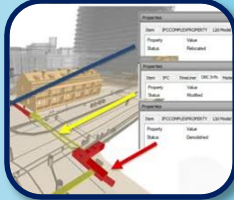
5. Skills and Resourcing



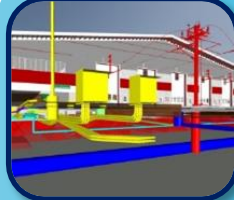
# Digital Twin



Laser scanning



Asset coding



3D modelling & collaboration



4D virtual construction



AR / VR visualisation



# Procurement



Commercial  
and legal  
framework



Standardised  
template  
documents



Scalable  
processes



Technical  
guidance



Project initiation  
support



# Ways of Working



DE Standard & technical guides



Smarter search capabilities



Open data formats



3D modelling & visualisation



Digital asset handover





# Technologies



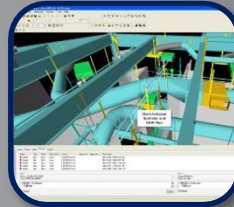
Common data environment



Pre-configured ECM platform



Mobile platform



BIM model review



Bulk drawings from BIM



## Skills and Resourcing



Consistent understanding



Role specific training



New skills for project management



New skills for design approval



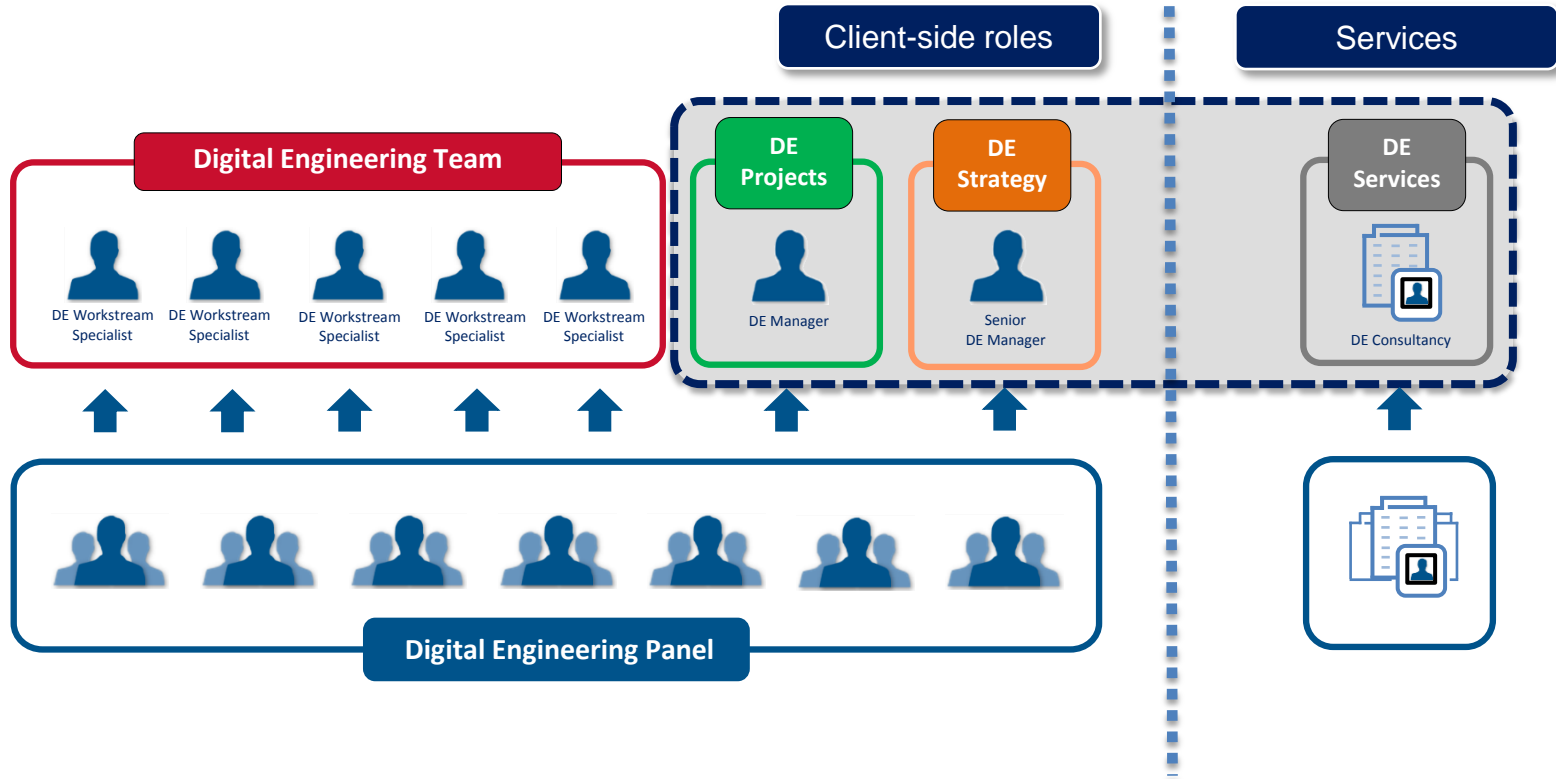
Pre-approved panel with DE expertise



Digital Engineering  
Framework  
Interim Approach



# DE Framework Panel



# DE Framework Panel - Services



## 1. Advisory

- A. Maturity Assessment
- B. Strategy Development and Planning
- C. Organisational Transformation
- D. Business Case Development
- E. Change Management
- F. Project Management
- G. Procurement



## 4. Data Management

- A. DE Business Architecture
- B. Data Schemas and Standards
- C. Data Migration
- D. BIM Object Library
- E. Large File Management
- F. Data Assurance/Validation



## 7. Visualisation

- A. Model Rendering and Animation
- B. Augmented Reality
- C. Virtual Reality



## 2. Business Processes

- A. Business Process Mapping/ Re-engineering
- B. Integration with Asset management
- C. Automation



## 5. Digital Site Investigation and Sensing

- A. Laser scanning
- B. Orthophotography and Photogrammetry
- C. UAVs (drones)
- D. Sensor based technologies



## 8. Education and Training

- A. Education
- B. Training



## 3. Technology

- A. Software Requirements and Integration
- B. Modelling Platforms
- C. Geospatial Platforms



## 6. Modelling and Connected Data

- A. Model production
- B. Geospatial production
- C. Connected data



## 9. Additional Digital Engineering Services

e.g. 3D printing, API development, Big Data, Internet of Things (IoT), Predictive Analysis, Machine Learning, Blockchain, Smart Cities/Infrastructure etc

# DE Framework Panel Details

- **General**

- Duration is 3 years, with an option to extend a further 2 years
- Membership is no guarantee of work, however DE Team will be working to promote panel opportunities/benefits
- Available to whole of NSW Government and panellists welcome to promote themselves to other agencies
- All procurement must be managed by DE Team

- **Procurement**

- Up to 6 months or \$150k in fees
- Outside those limits, client must approach 3 panellists
- Variation limits based on manager delegations

# Next Steps



Commence



Q3 2018  
Go Live



Mid 2019



Late 2019



End 2019  
End Stage 1

## TfNSW I&S Division

### Interim Approach Release 1

- Requirements for CAD, BIM, 4D & ECM
- Digital Survey outputs

### Interim Approach Release 2

- Requirements for Digital Survey, GIS, 5D, 6D & Systems Engineering

### Interim Approach Integrated (APIs)

- Integrated CAD, BIM, 4D, 5D, 6D & Systems Engineering for I&S

### Digital Engineering Framework (DEF)

- Complete workstreams
- Stage 2 Business Case

## Transport Cluster

### Early Engagement

- Key stakeholders

### Interim Approach Release 1

- Promote/Support Pilots

### Interim Approach Release 2

- Adapt for Agencies
- Promote/Support Pilots

### Interim Approach Integrated

- Adapt for Agencies
- Promote/Support Pilots

## Industry

### Initial Comms

- Website
- Industry Competition

### Engagement

- Pilot Projects
- Refresh Panel
- Regular Forums

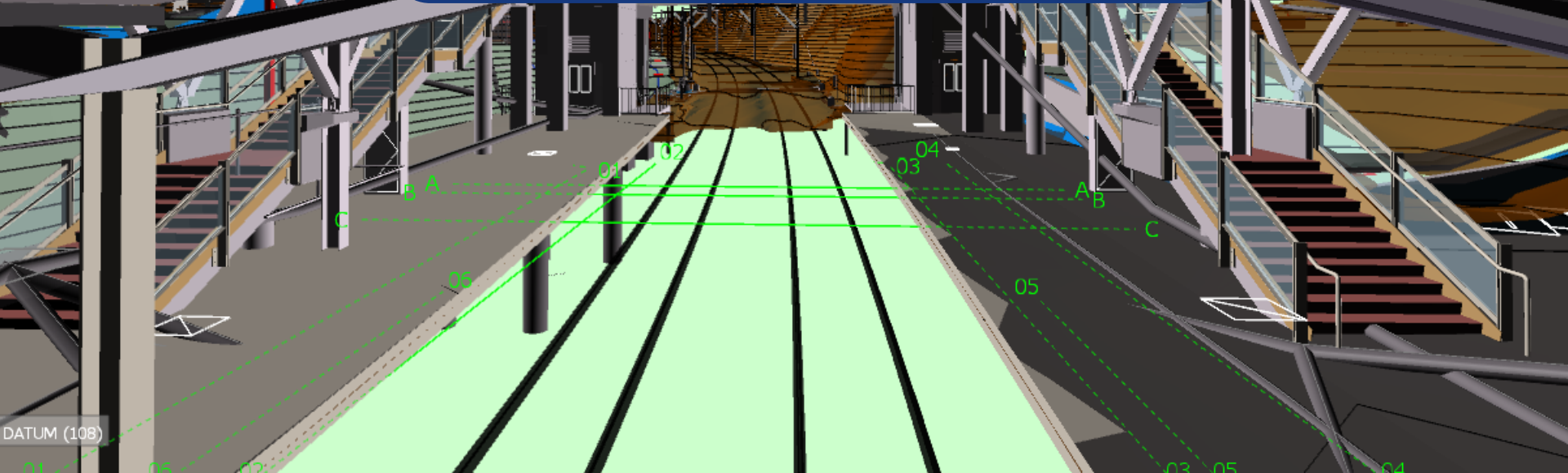
### Development

- Pilot Projects
- Community of Practice

### Collaboration

- Showcase best practice
- Continual learning

# The Digital Engineering Framework is here





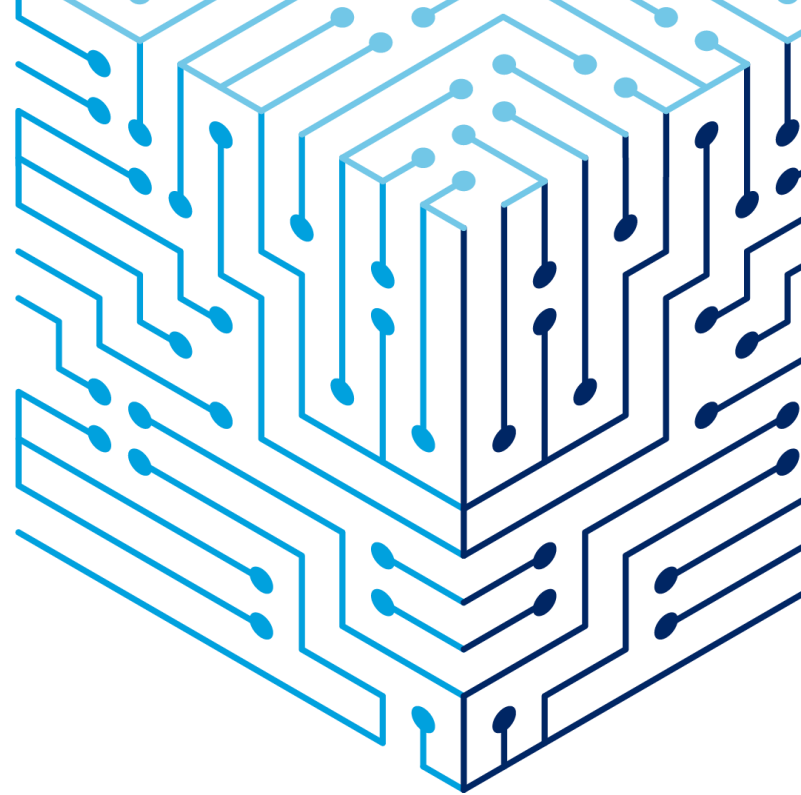


# Digital Engineering Framework Program

Interim Approach

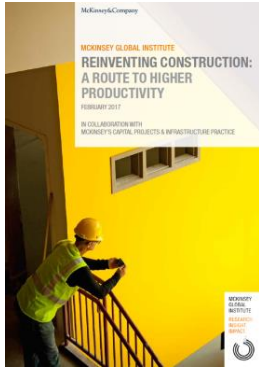
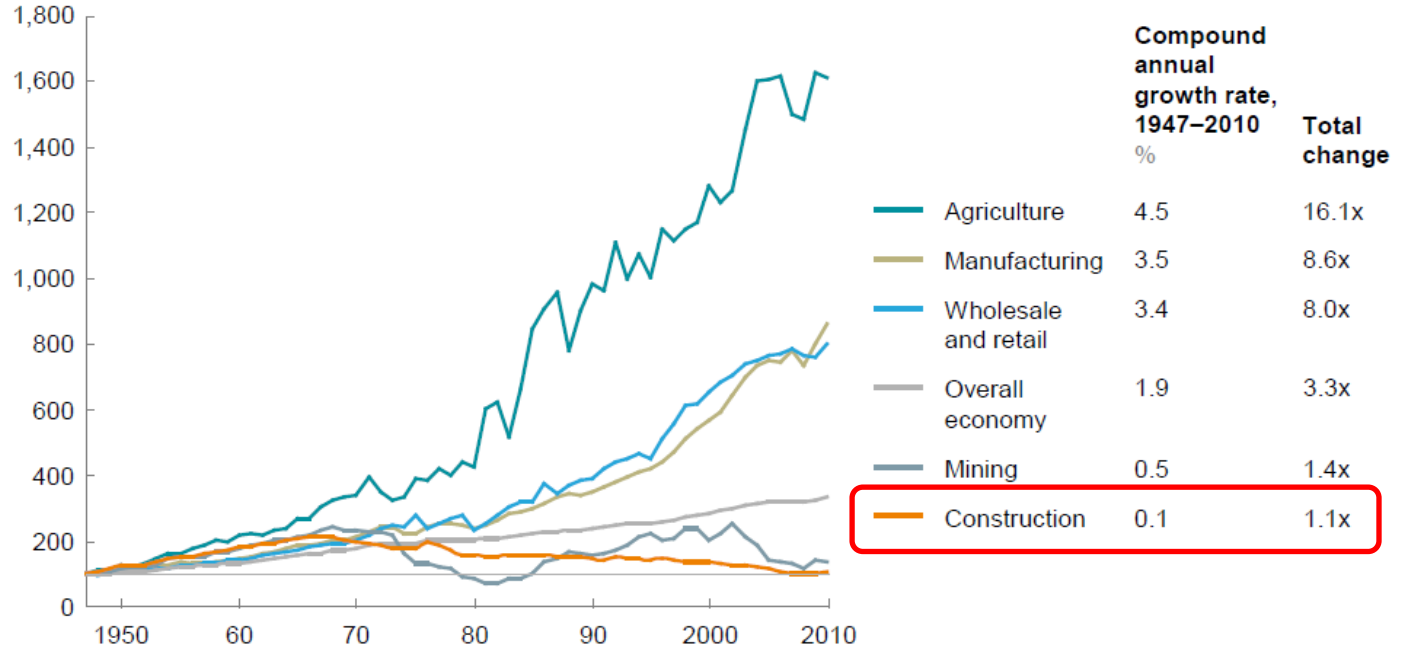
**Adam Griffiths**

Program Manager Digital Engineering



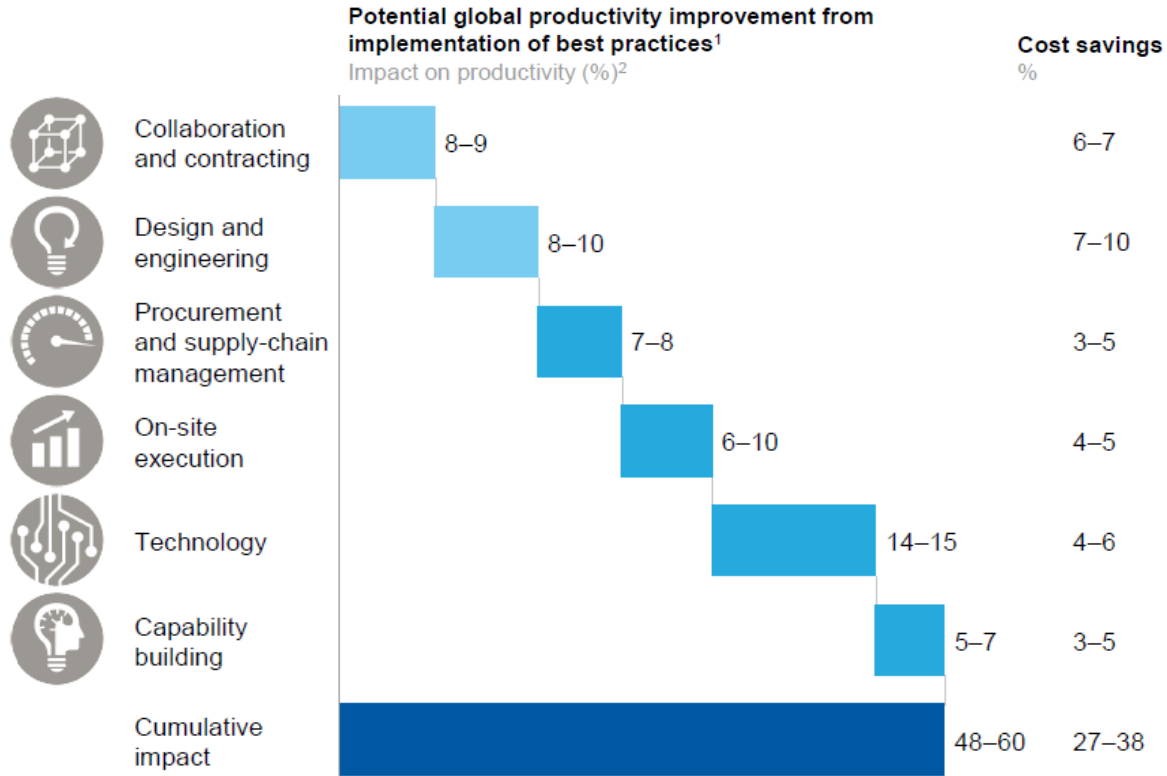
# AEC Sector Productivity

Gross value added per hour worked, constant prices  
Index: 100 = 1947



Source: [Reinventing Construction: A route to higher productivity \(McKinsey&Company\)](#)

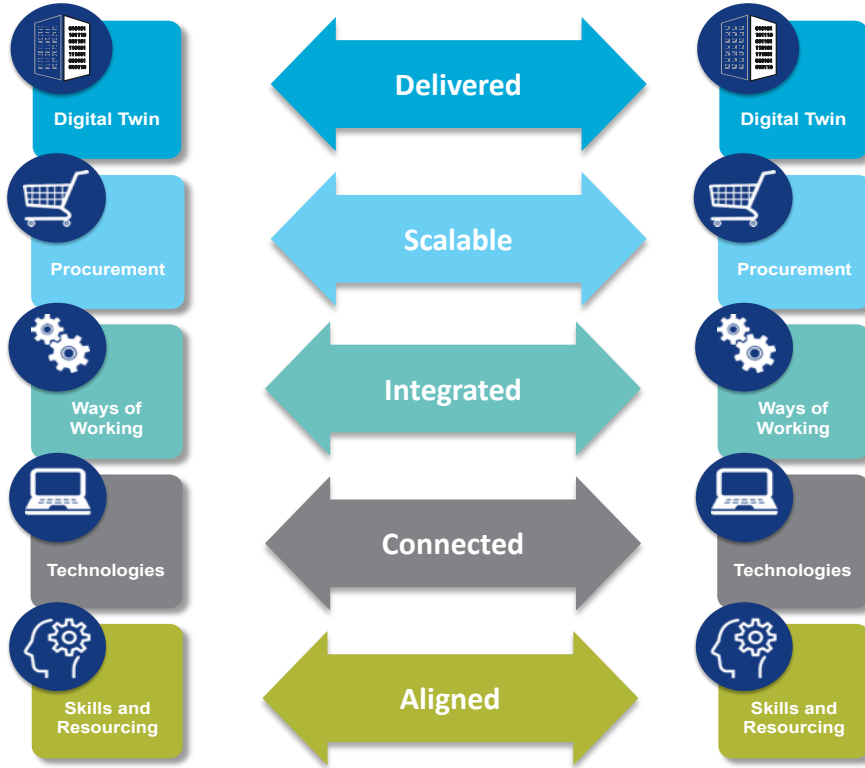
# Seven productivity improvement areas



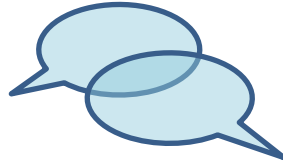
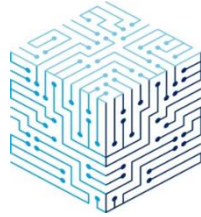
# Principles of the DE Framework



Transport  
for NSW



# Core Enablers of the future state of DE?

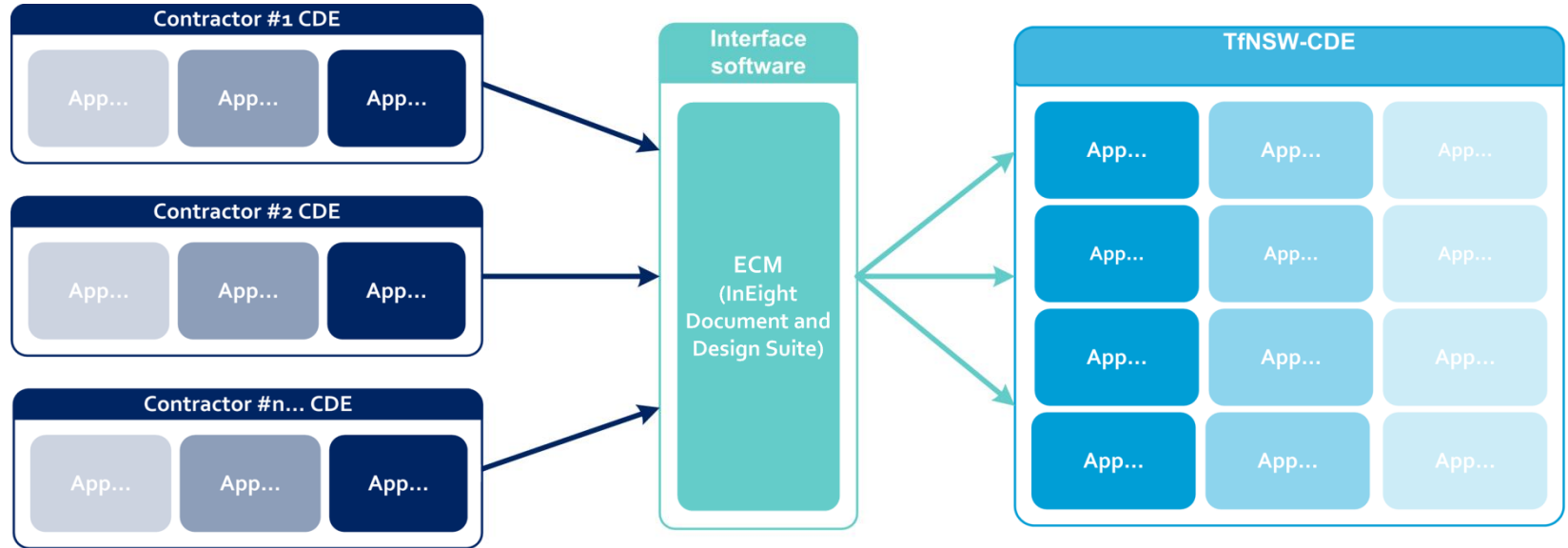


**Common Data Environment**

**Open Data Formats (IFC)**

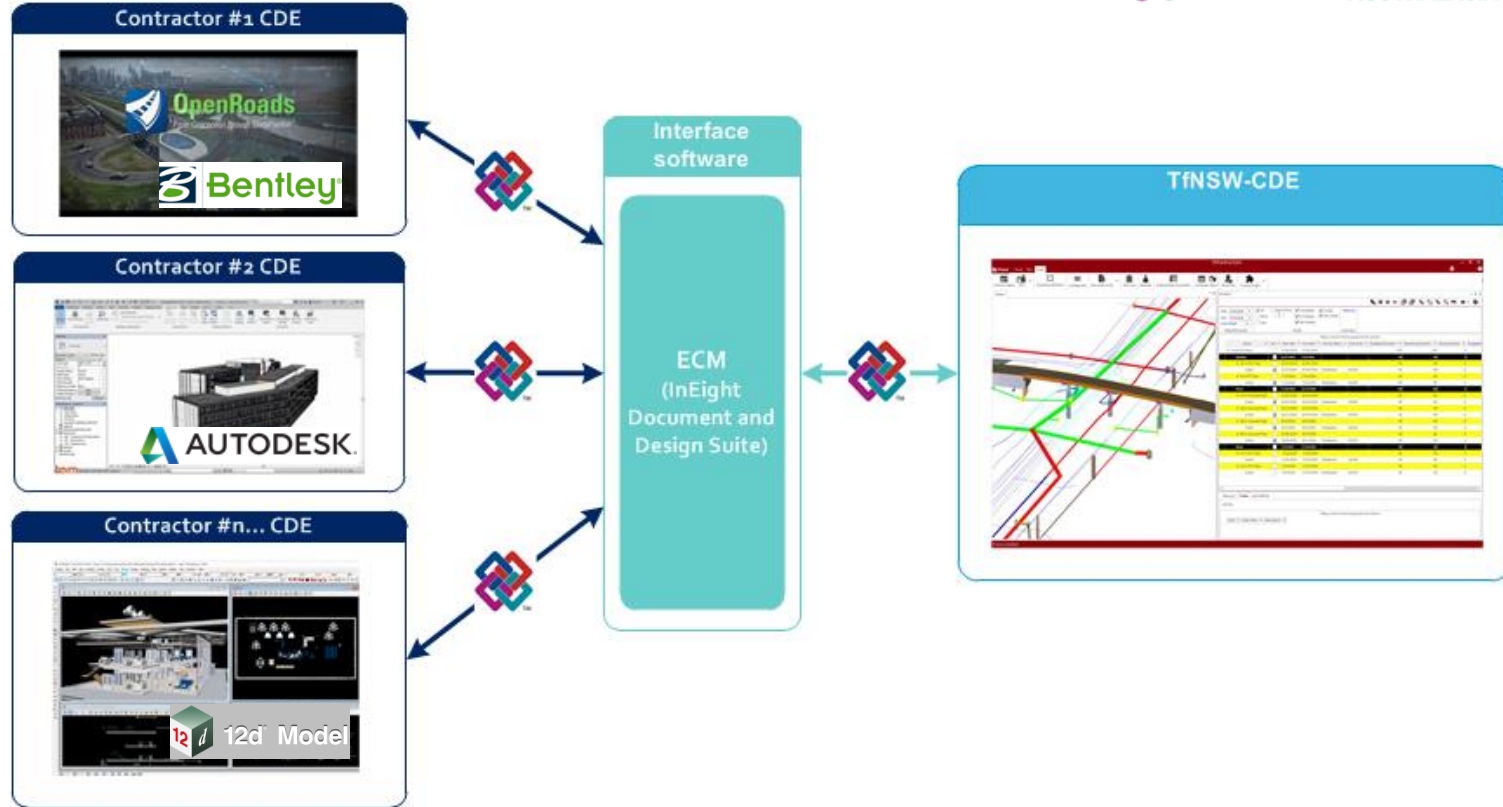
**Data Classification and Referencing**

# Common Data Environment (CDE)



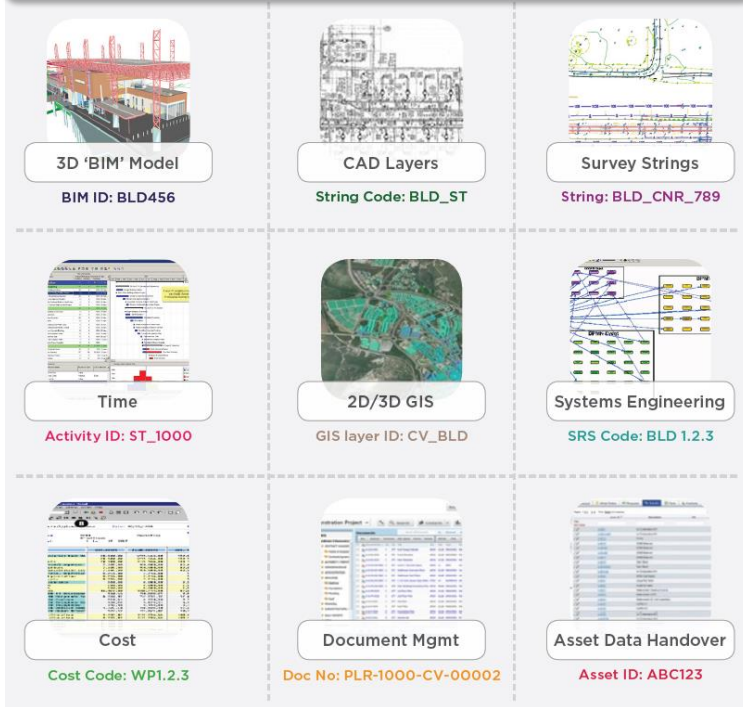


# Open Data Formats

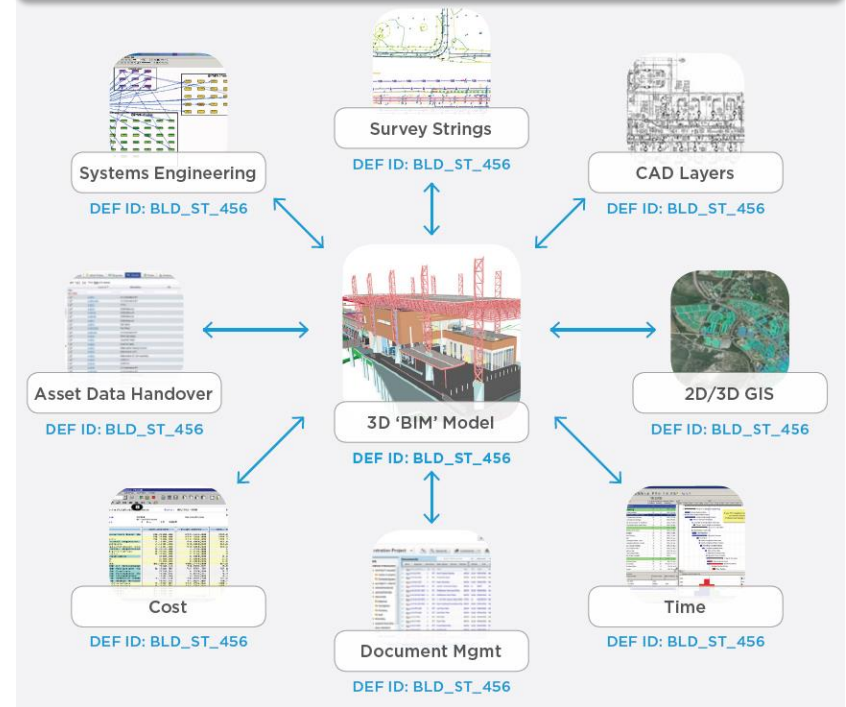


# Data Classification and Referencing

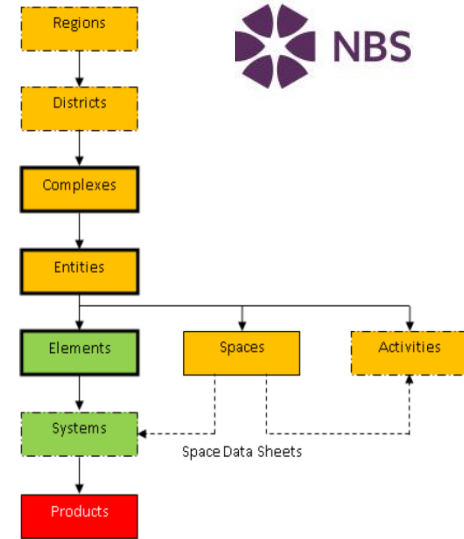
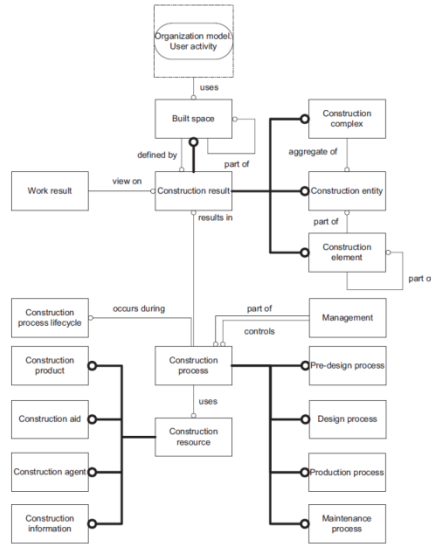
## Current State



## Future State



# The importance of Classification



**ISO 12006-2:2015**  
Building construction  
Organization of information about construction works  
**Part 2: Framework for classification**

**Uniclass 2015**  
Unified classification for the UK industry  
covering all construction sectors

# DE Data Classification and Coding

## Discipline Codes

## UniClass2015

### Discipline Classification

Business Discipline

Technical Discipline

### Asset Classification

Elements/  
Functions (EF)

Systems (Ss)

Products (Pr)

### Location Classification

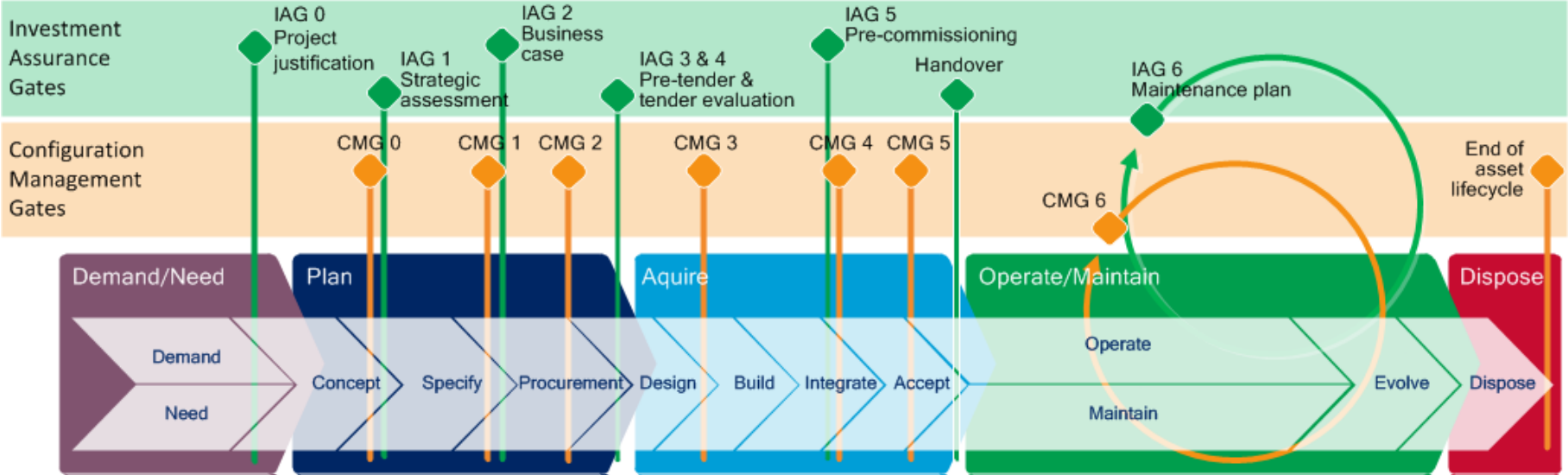
Complexes (Co)

Entities (En)

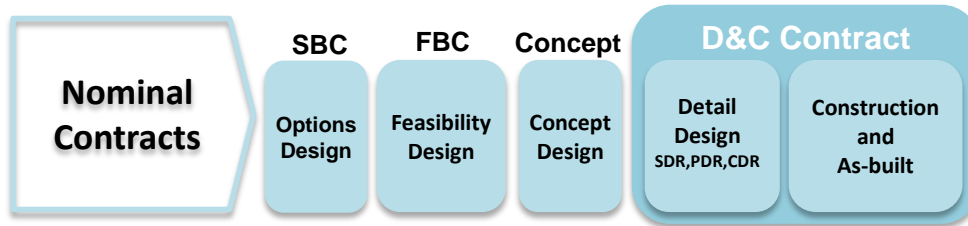
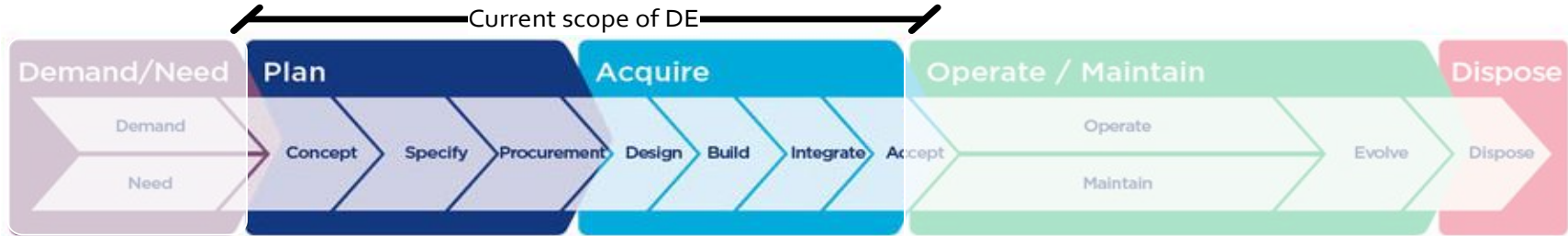
Spaces/  
Locations (SL)



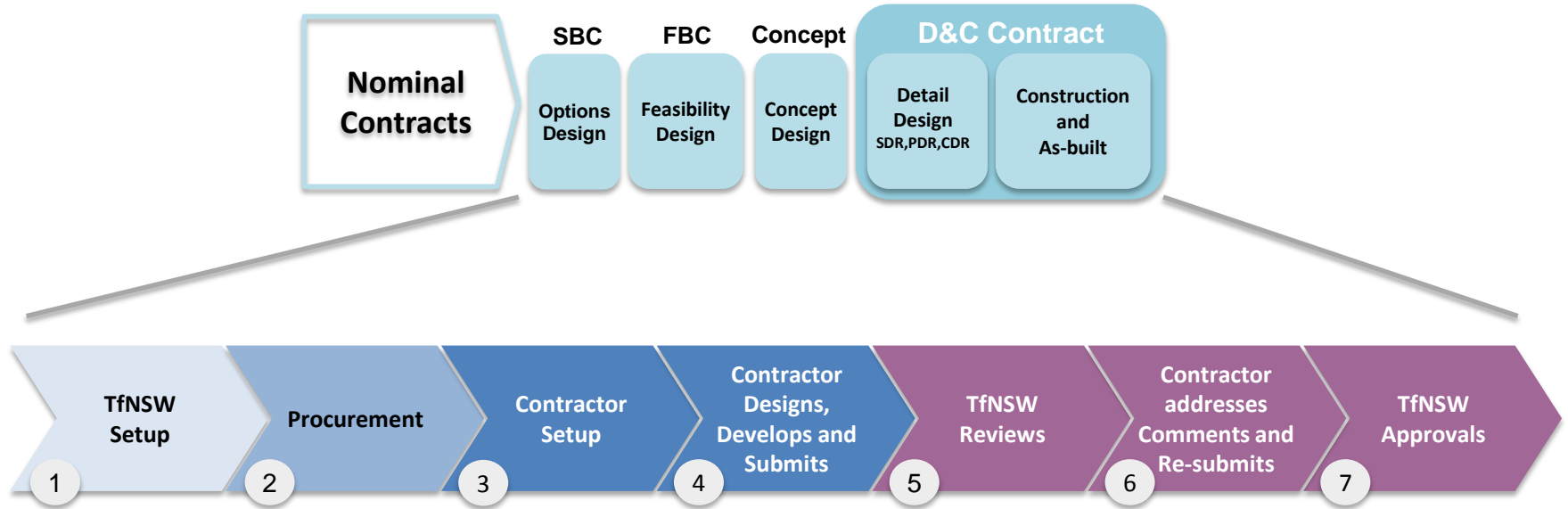
# Project Lifecycle



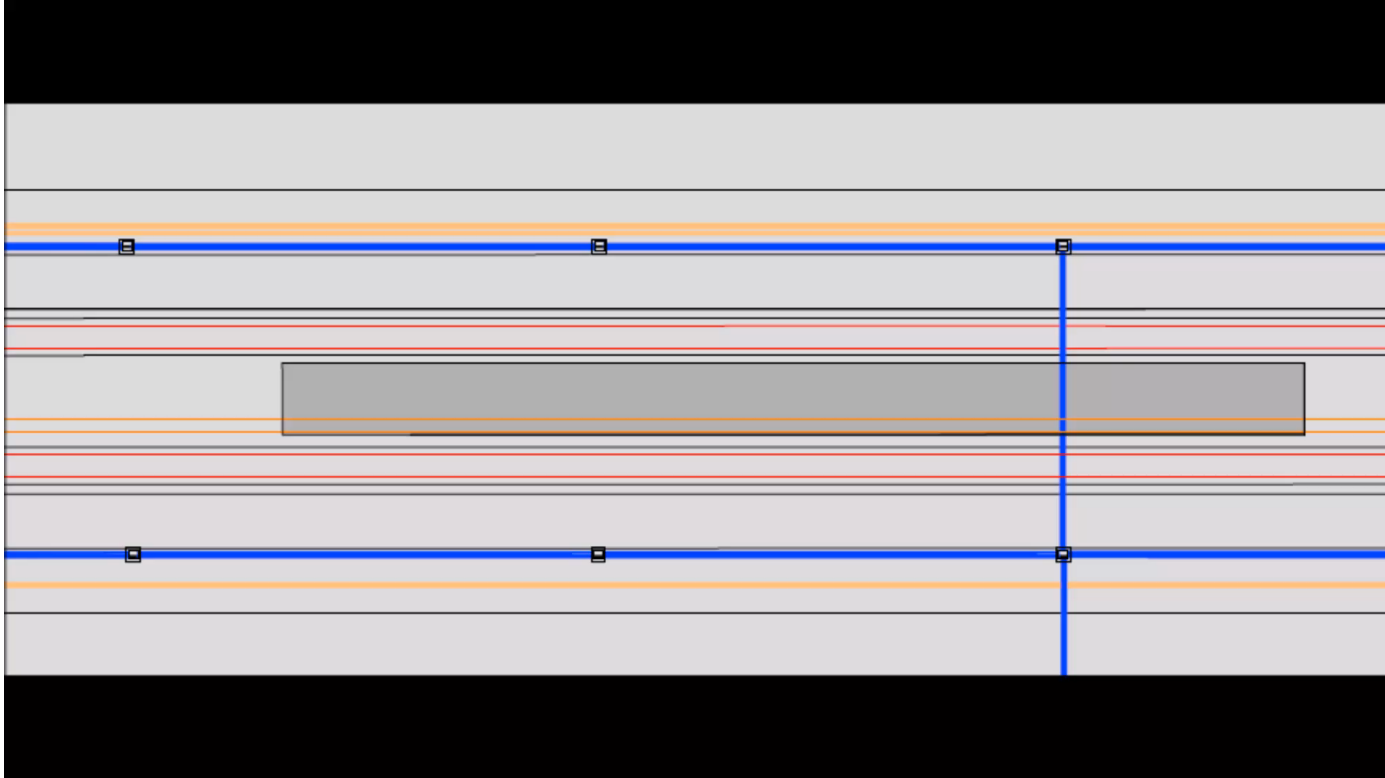
# Scope of DE Framework



# Alignment with TfNSW Management Steps

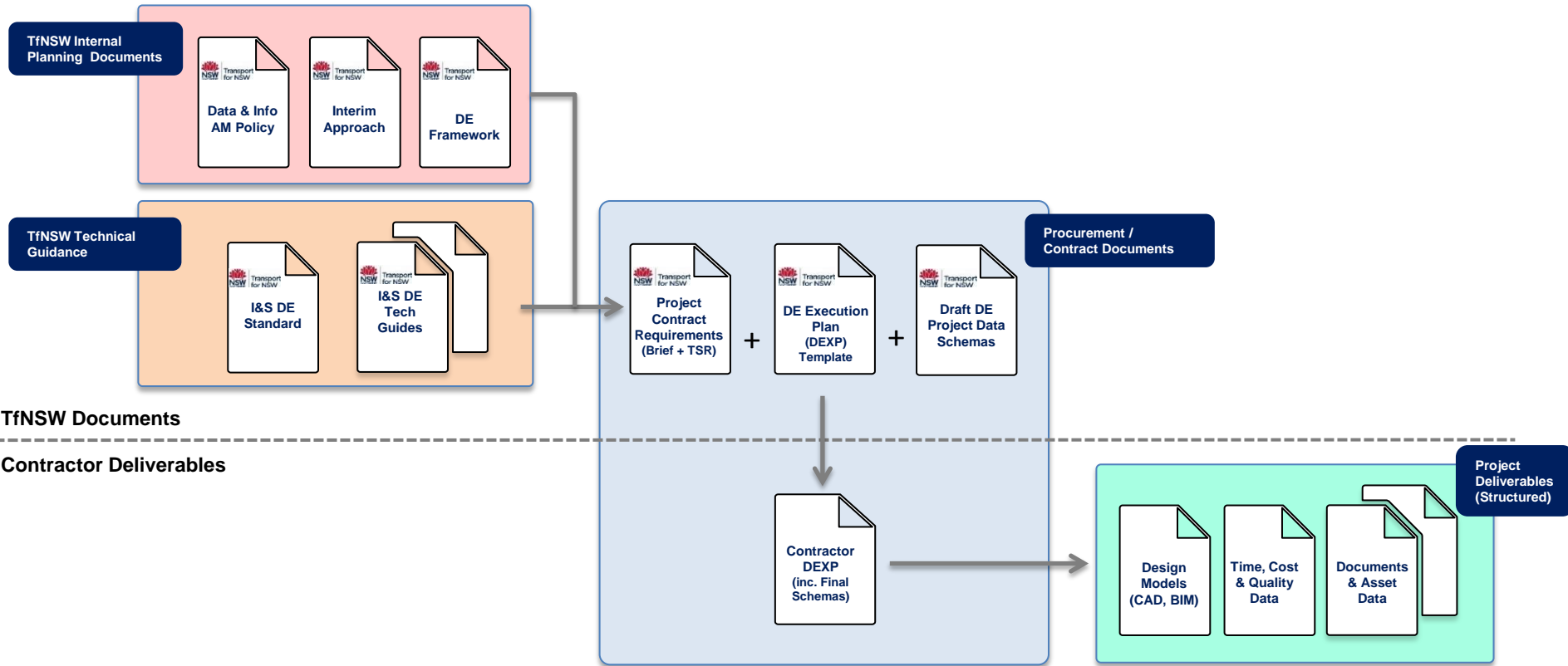


# DE for each stage of the project lifecycle





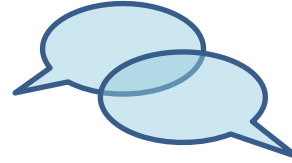
# DE Framework Interim Approach Documents



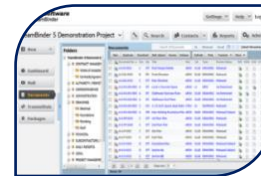
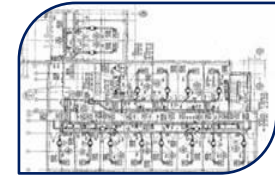
# I&S DE Standard



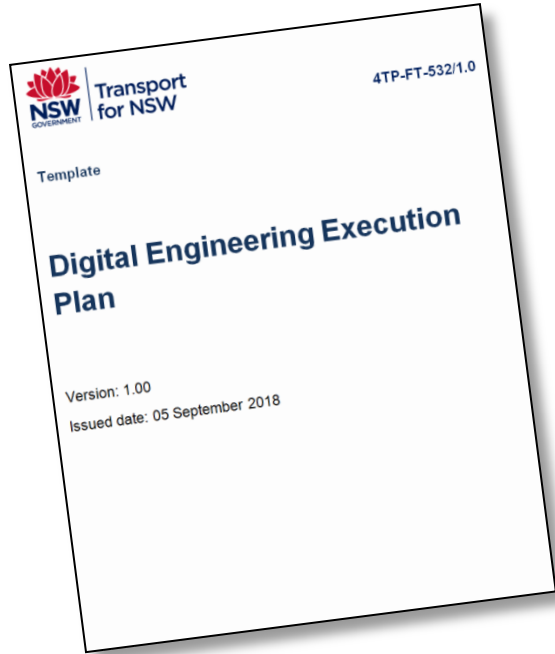
## 1. Specifies three core enablers



## 2. Specifies DE requirements



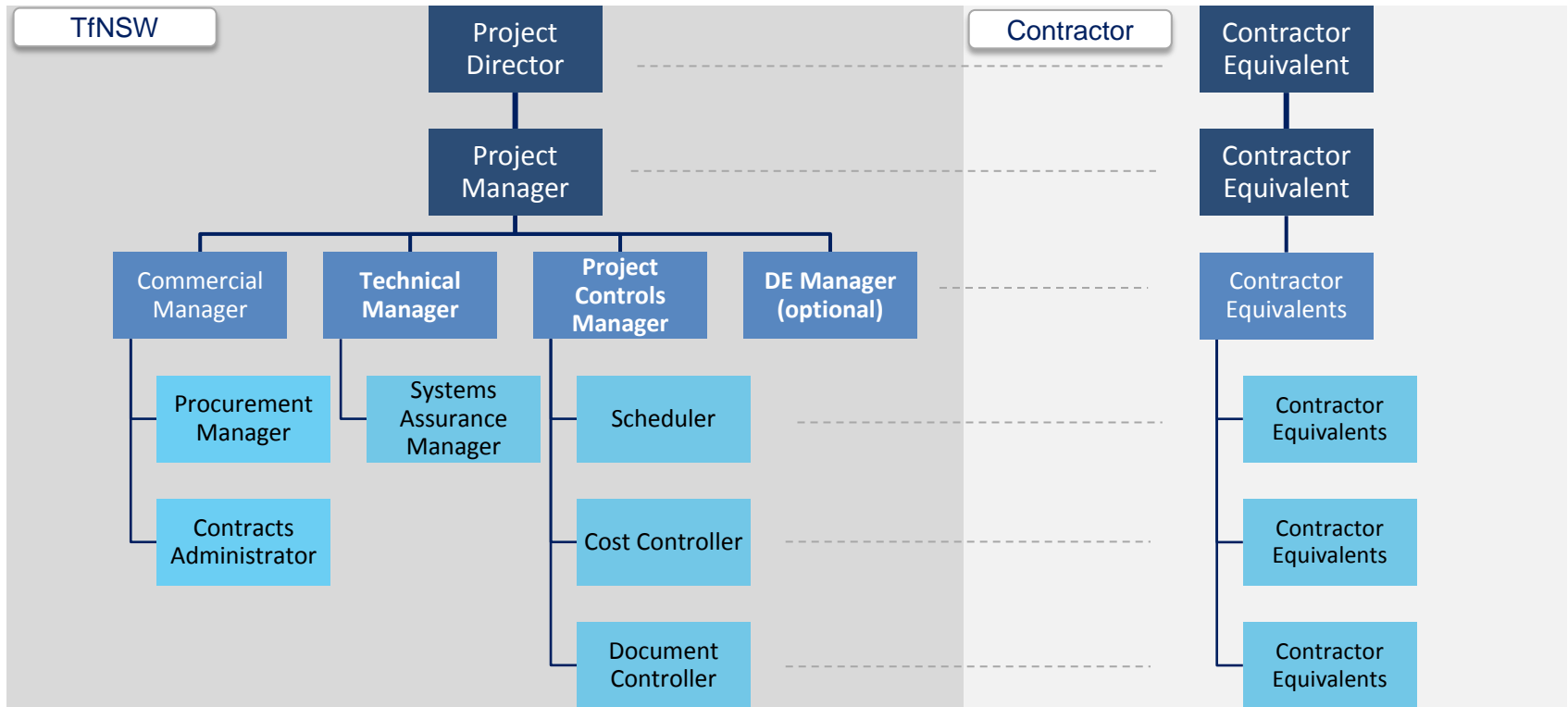
# DE Execution Plan (DEXP) Template



## Contractor to document:

1. Collaboration - internally and with TfNSW
2. Use of technologies
3. Data classification
4. Management of DE Deliverables
  - Documentation
  - Digital Survey
  - BIM & CAD
  - Schedule
  - Asset Handover
5. Review and quality assurance
6. Information Exchange process

# Skills and Resourcing





# DE Framework Training

## Awareness

### Fundamentals

Step 1  
TfNSW Setup

Step 2  
Procurement

Steps 3 & 4  
Contractor Setup  
and Delivery

Steps 5 to 7  
Review of  
Submissions

### Specialist training

Application of  
Classification

BIM & CAD

Digital Survey

Schedule

### Future training (TBC)

Survey

3D Visualisation

GIS

Asset Handover

Value  
Management

Cost

Systems  
Engineering

# What's the end goal?



# How can industry prepare?



1. Setup an integrated Common Data Environment



2. Practice outputting in open data formats (IFC)  
3. Embed UniClass2015 in your business



4. Develop design rules libraries



5. Design for Manufactured Assembly (DfMA)  
6. Partner with off-site manufacturing suppliers



7. DE Education, including subcontractors

# How to get started?



## Online

<http://www.transport.nsw.gov.au/DigitalEngineering>

Download the Framework, DE Standard and DE Execution Plan Template today!!!



## Get in touch

[Digital.Engineering@transport.nsw.gov.au](mailto:Digital.Engineering@transport.nsw.gov.au)

We want to collaborate with anyone working in the DE space



## Technical skills

DE Training will be available to Contractors engaged on TfNSW projects

# Questions?



**Simon Vaux**

Director Digital Engineering  
[simon.vaux@transport.nsw.gov.au](mailto:simon.vaux@transport.nsw.gov.au)



**Adam Griffiths**

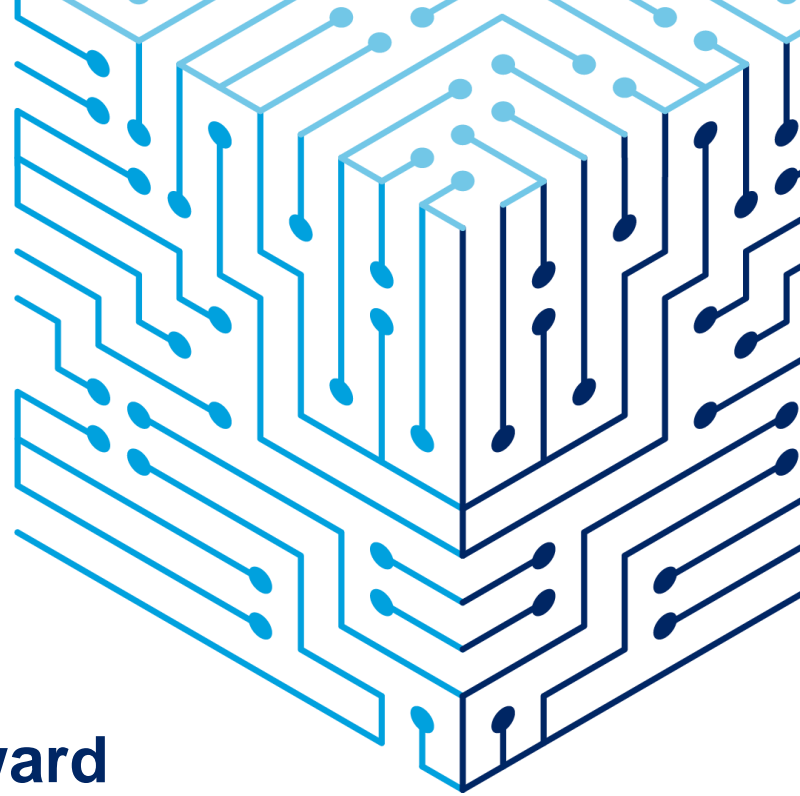
Program Manager Digital Engineering  
[adam.griffiths3@transport.nsw.gov.au](mailto:adam.griffiths3@transport.nsw.gov.au)





# Digital Engineering Framework

2018 Connecting Smarter Award



# The Finalists

Norman Disney & Young

JHCPBG JV

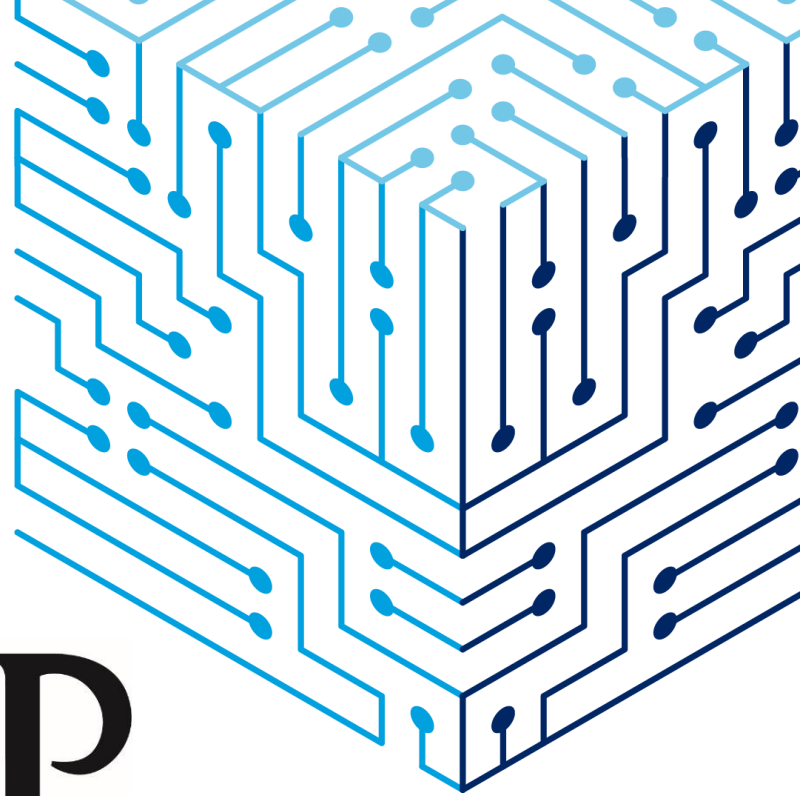
Aurecon

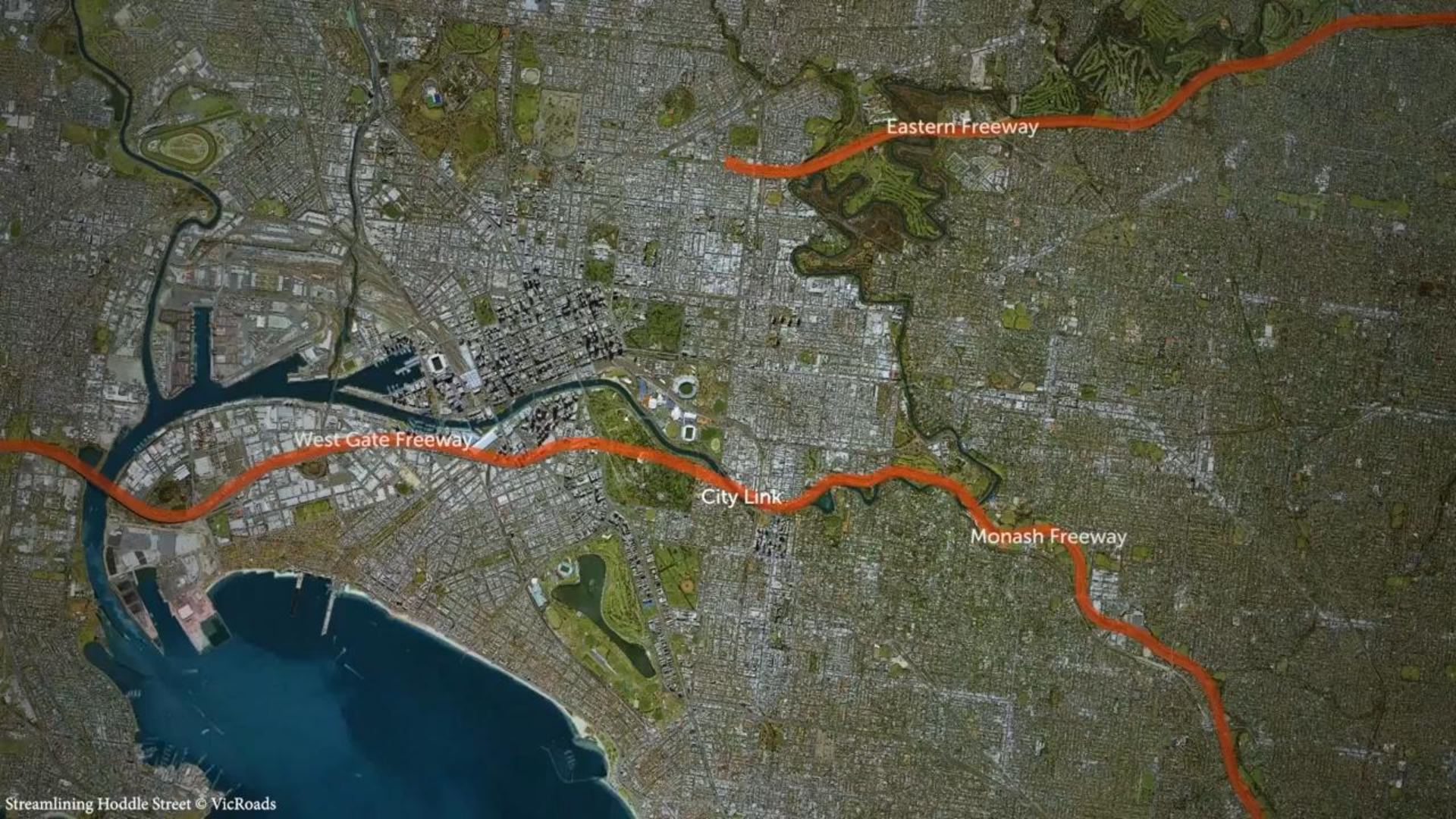
Willow

Arup

**The winner is...**

**ARUP**





Eastern Freeway

West Gate Freeway

City Link

Monash Freeway