



◀ Crossrail Constructing Excellence

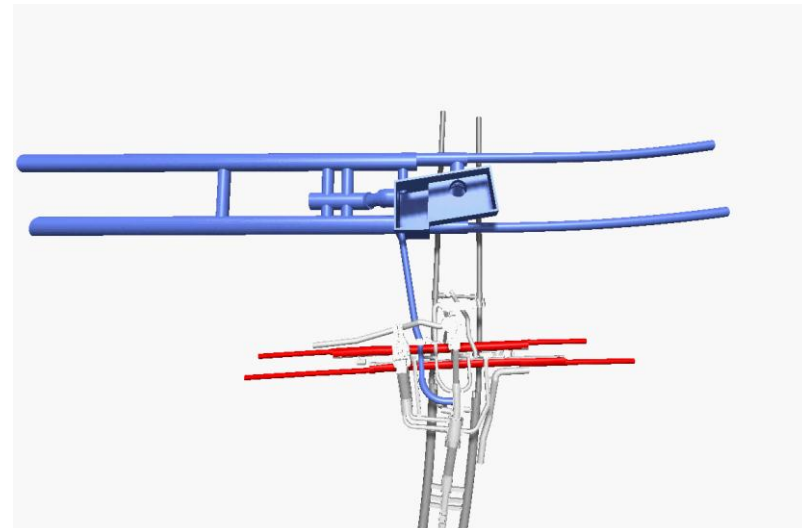
- ◀ **Malcolm Taylor**
- ◀ **Head of Technical Information**
- ◀ **Crossrail Ltd**
- ◀ **26th March 2014**

MOVING LONDON FORWARD



- ▶ Where are we up to?
- ▶ Asset Information
- ▶ BIM in Asset Management
- ▶ Innovation

*- Using Crossrail as a
'worked example'*



◀ **Where are we up to?**

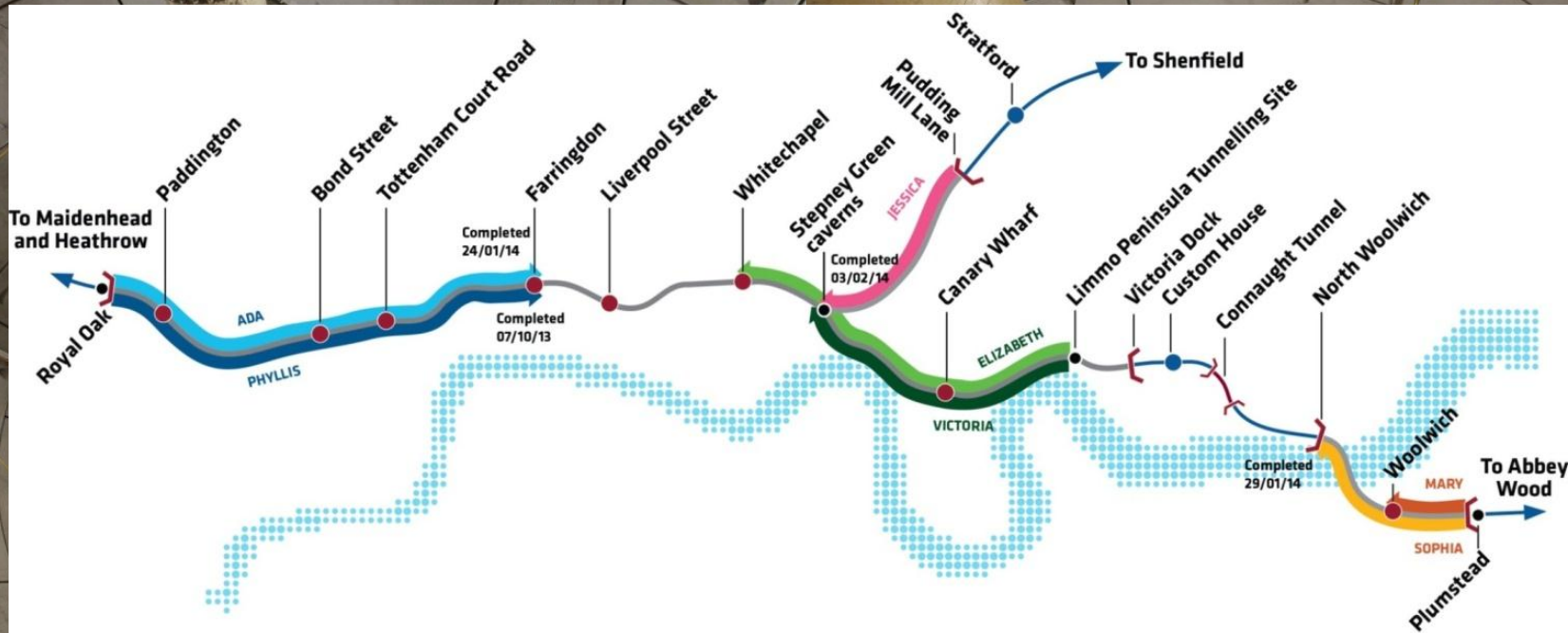


Halfway There





Western Tunnels Complete





Many breakthroughs!





Miles of SCL





The new rolling stock

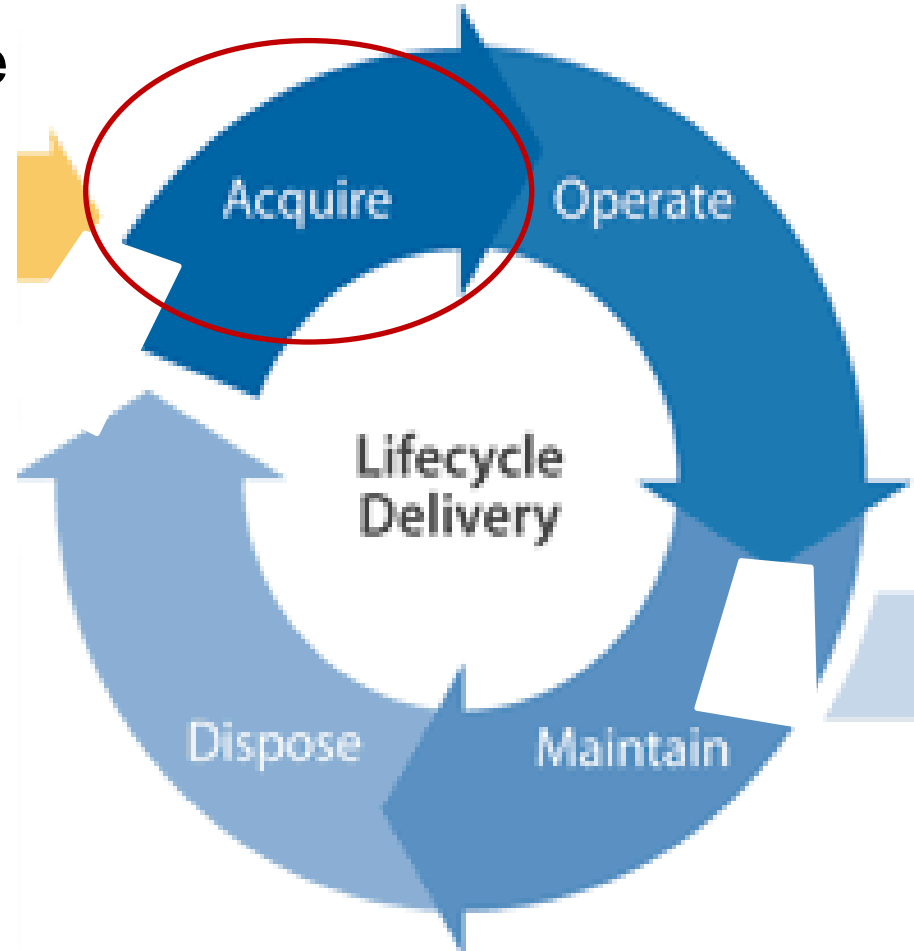


◀ **Asset Information**

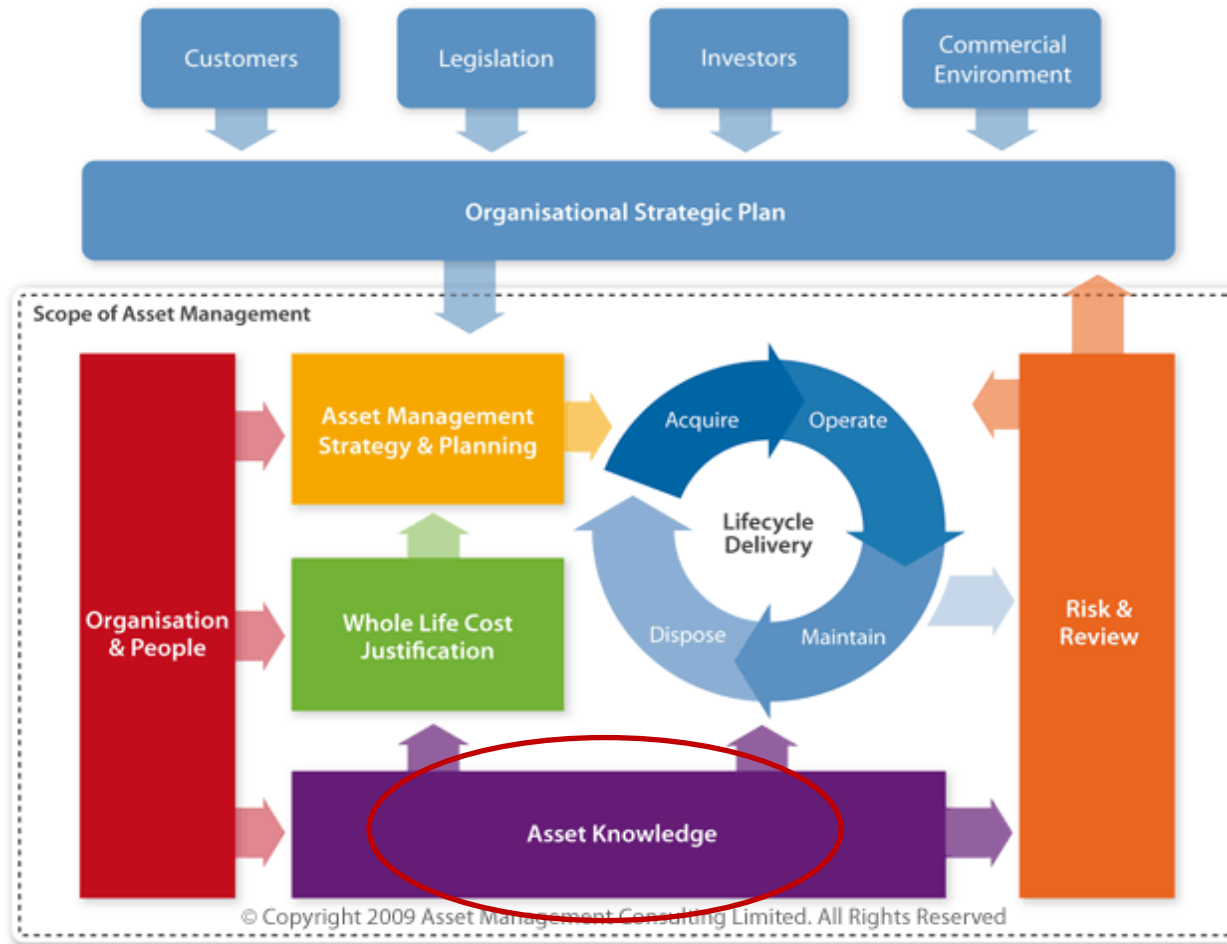


Asset Lifecycle

Crossrail
Programme

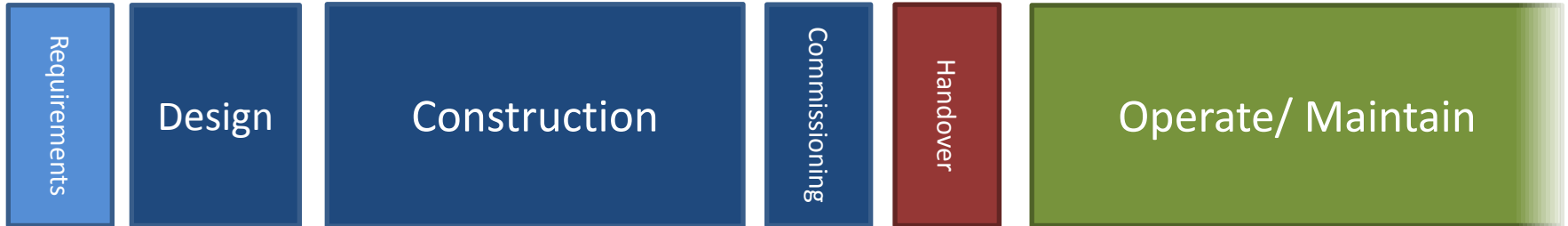


Asset Management Landscape





Asset Information timeline



Traditional



Late?
Poor quality?
Inefficient?

Crossrail



On time
Good quality
Efficient

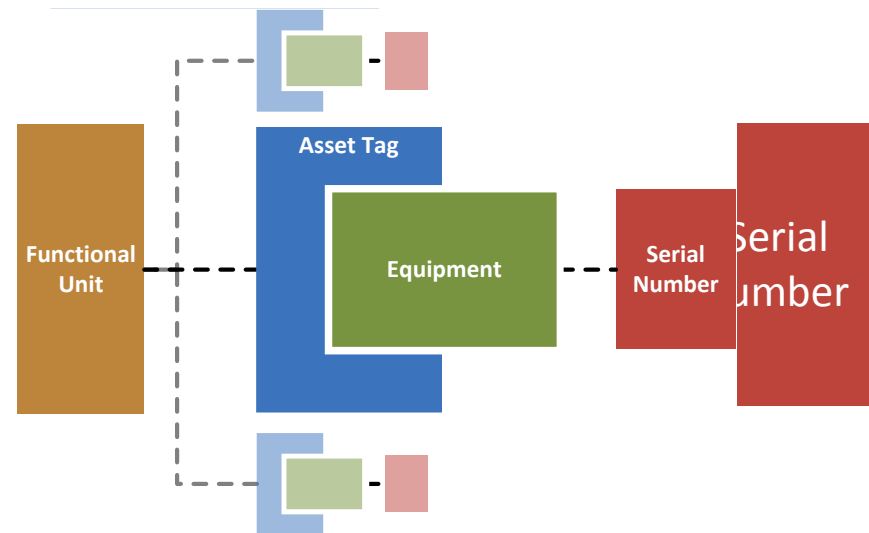




Key Concepts

- ▶ Asset
- ▶ AIMS
- ▶ Asset Tag
- ▶ Equipment
- ▶ Serialised Items
- ▶ Functional Units

How does AIMS represent an asset?



- Tag – a specific duty or role on the railway
 - e.g. Drainage Pump 1
- Equipment – the actual physical item performing the duty of a Tag
 - e.g. Acme Model B Pump
- Serial – The serial number of an individual instance of Equipment
 - e.g. 12345
- Functional Unit – A number of Tags that work together as a system
 - e.g. Drainage Pumping Station



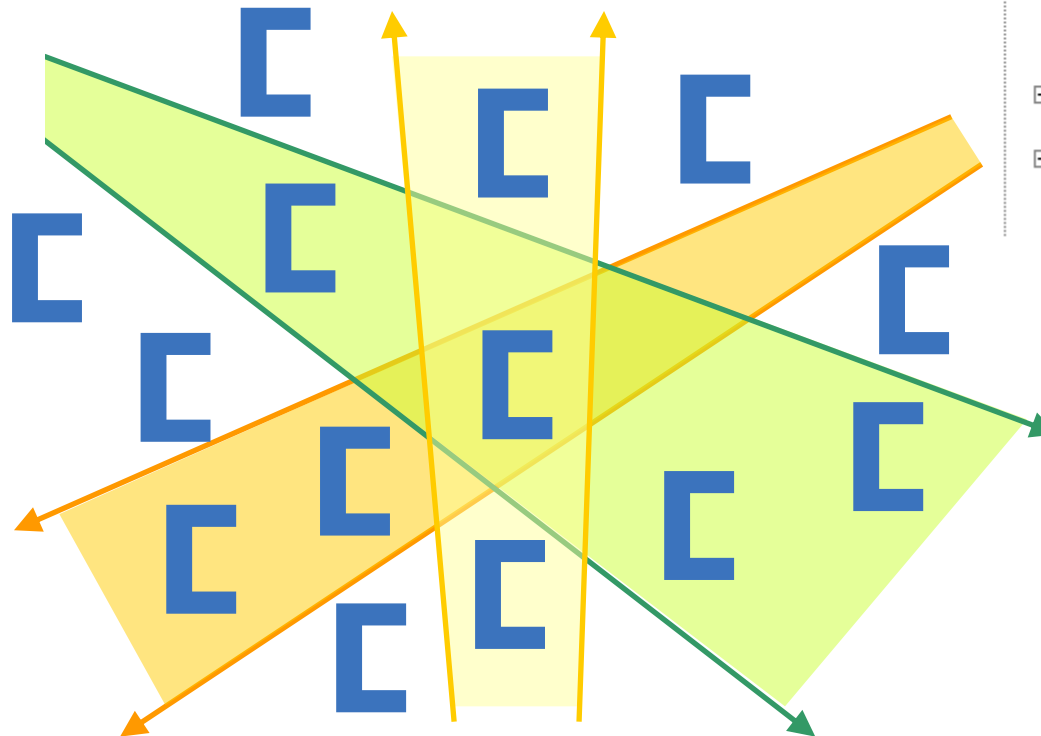
Asset Tag Definition

- [-] Royal Oak Portal
 - [-] Royal Oak Portal Level 1
 - [+] ROP - L1 - Access Corridor
 - [+] ROP - L1 - Communications Equipment Room
 - [+] ROP - L1 - Emergency Switch Room
 - [+] ROP - L1 - Escape Landing
 - [+] ROP - L1 - Fan Room
 - [+] ROP - L1 - Fire Equipment Room
 - [+] ROP - L1 - Fire Suppression Room 1
 - [+] ROP - L1 - Fire Suppression Room 2
 - [+] ROP - L1 - HV Switch Room 1
 - [+] ROP - L1 - HV Switch Room 2
 - [+] ROP - L1 - Intervention Corridor
 - [+] ROP - L1 - Intervention Stairs
 - [+] ROP - L1 - LV Switch Room 1
 - [+] ROP - L1 - LV Switch Room 2
 - [+] ROP - L1 - Motor Control Centre

Location

Where is the asset?

Collection of Asset Tags



- [-] Crossrail Functional Breakdown
 - [+] FB-BS - Building Systems
 - [+] SB-BS-C - Cable Routing
 - [+] SB-BS-DR - Drainage rain water
 - [+] SB-BS-DW - Drainage waste water
 - [+] SB-BS-E - Electrical
 - [+] SB-BS-EL - Emergency Lighting
 - [+] SB-BS-ES - Escalator
 - [+] SB-BS-FD - Fire Detection
 - [+] SB-BS-FS - Fire Suppression
 - [+] SB-BS-H - HVAC
 - [+] SB-BS-L - Lift
 - [+] SB-BS-LG - Lighting

Function

What is the asset designed to perform?

Classification

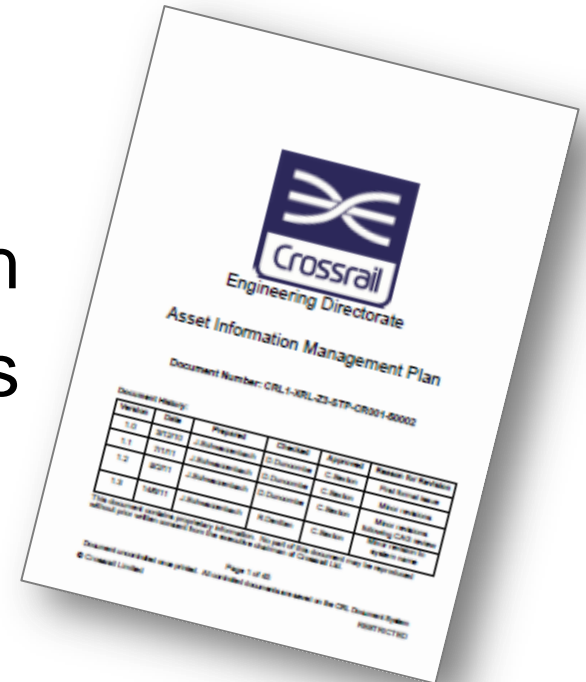
What type of asset is it?

- [-] L - Construction Products
 - [-] L1 - Ground treatment and retention products
 - [+] L11 - Ground anchorages
 - [+] L12 - Ground improvement
 - [+] L13 - Land/field drainage
 - [+] L14 - Sheet piling, revetments



Asset Information Management Plan

- ▶ Defines Crossrail's overall approach to asset information
- ▶ Specifies governance approach
- ▶ Lists key supporting documents and links to other documents/standards





Asset Identification Standard

CR501-CDR-00001



DRAINAGE PUMP 1

EQ000041832

PUMP, SUBMERSIBLE-ACME-CD4515-114

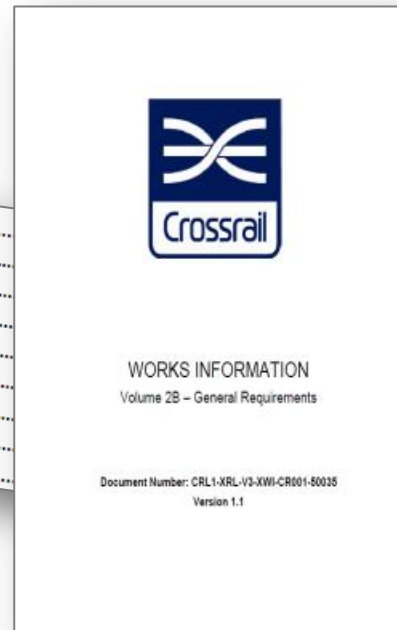
2011/526/50A/0004



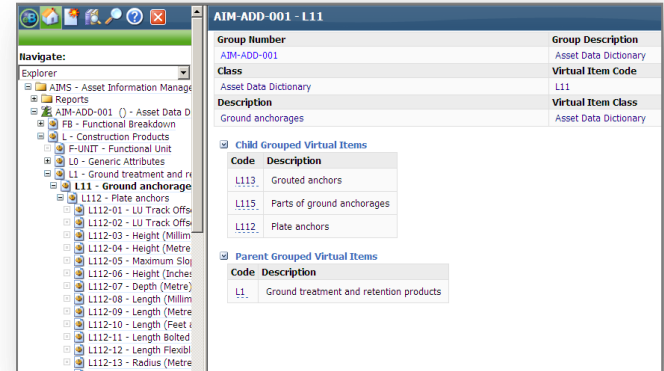
- ▶ Defines:
 - ◆ Asset ID format
 - ◆ Asset name formats
 - ◆ Asset labelling requirements
- ▶ Datamatrix bar codes laser engraved on label

- ▶ Works Information 2B Section 13.5
- ▶ Clarifies requirements for Contractors
- ▶ Good practice, but not novel, approaches

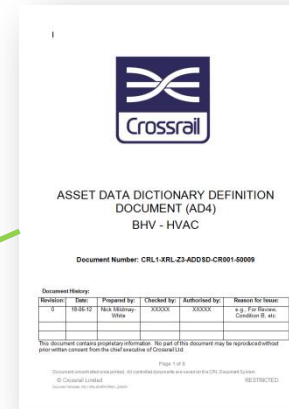
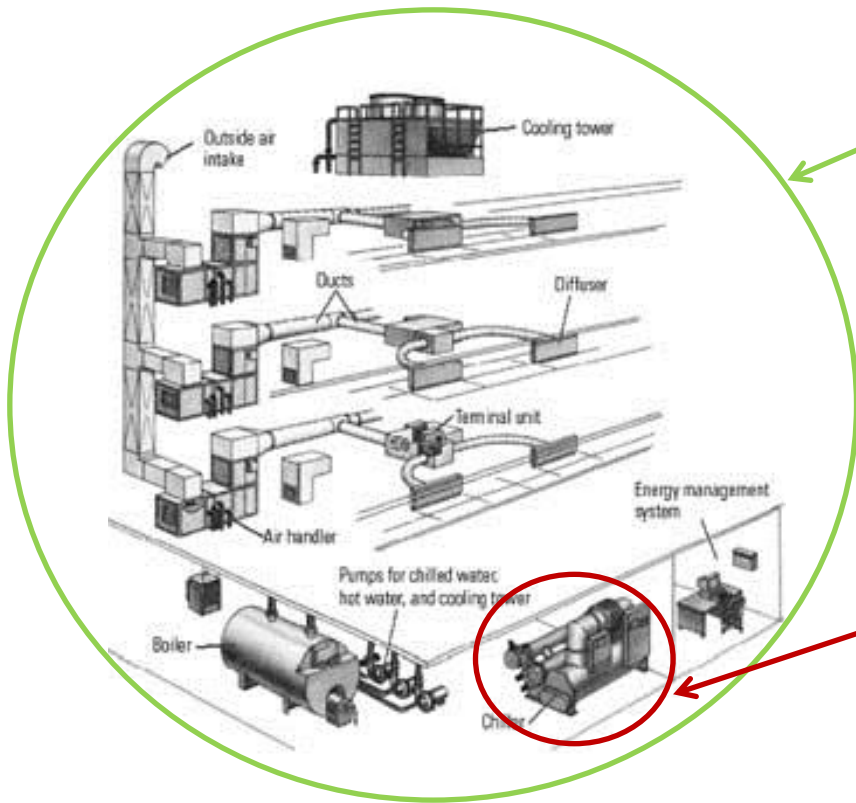
Part 13 – Assurance, Records and Certification
13.1 Introduction
13.2 Assurance
13.3 Deliverables and Records
13.4 Certification to be Provided
13.5 Asset Management & Traceability
13.6 Critical Readiness Review
13.7 Appendices
Part 14 – Management and Administration



- ▶ Defines the types of assets of interest to Crossrail
- ▶ Asset Data Dictionary Definition Documents (AD4) define:
 - ◆ Functions and the Classes that relate to them
 - ◆ Classes and the Attributes relevant to them
 - ◆ What an Attribute means e.g. Length
- ▶ Demonstrates how to define an asset for a specific class

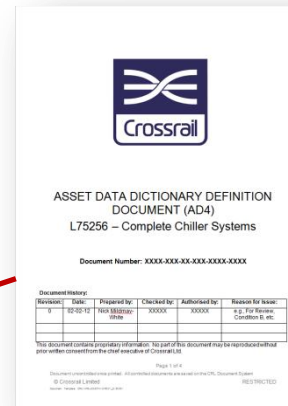


Air Conditioning System



HVAC Functional AD4:

- Defines System
- Lists applicable Assets
- Classes
- Generic functional naming conventions
- Generic labelling
- Worked examples



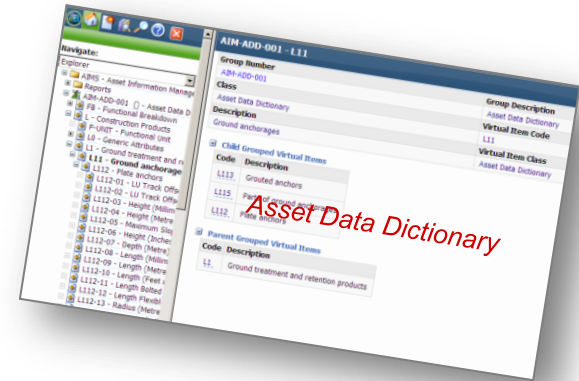
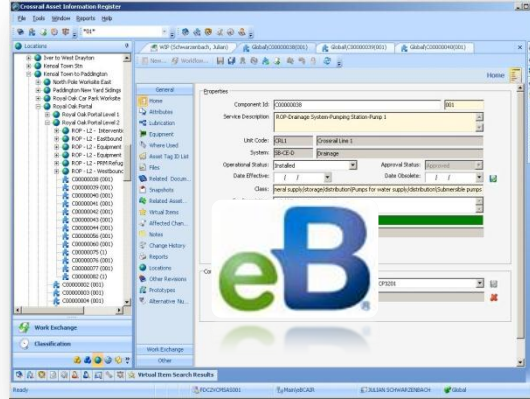
Chiller Class AD4:

- Defines Asset
- Visual examples
- Specific naming conventions
- Lists performance data requirements
- Lists attribute requirements

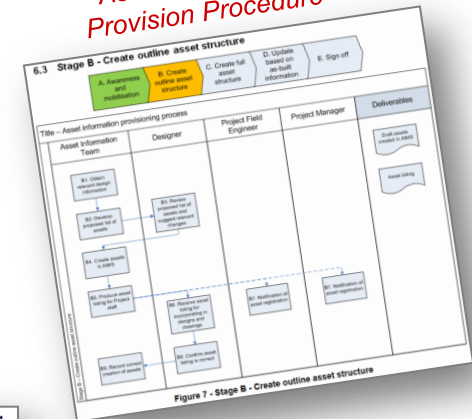


Enablers

Asset Information Management System



Asset Information Provision Procedure



Asset Information Management Plan



Standard

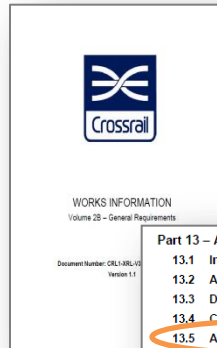
ASSET IDENTIFICATION STANDARD

Document Reference: CR-470-018
Issued on: 08/11/09, 08/02/2010, 08/01/2011
Classification: Standards Manager

Version	Issue Date	Author	Reviewer	Approved
1.0	08/11/09			
1.1	08/02/2010			
1.2	08/01/2011			

Asset Identification Standard

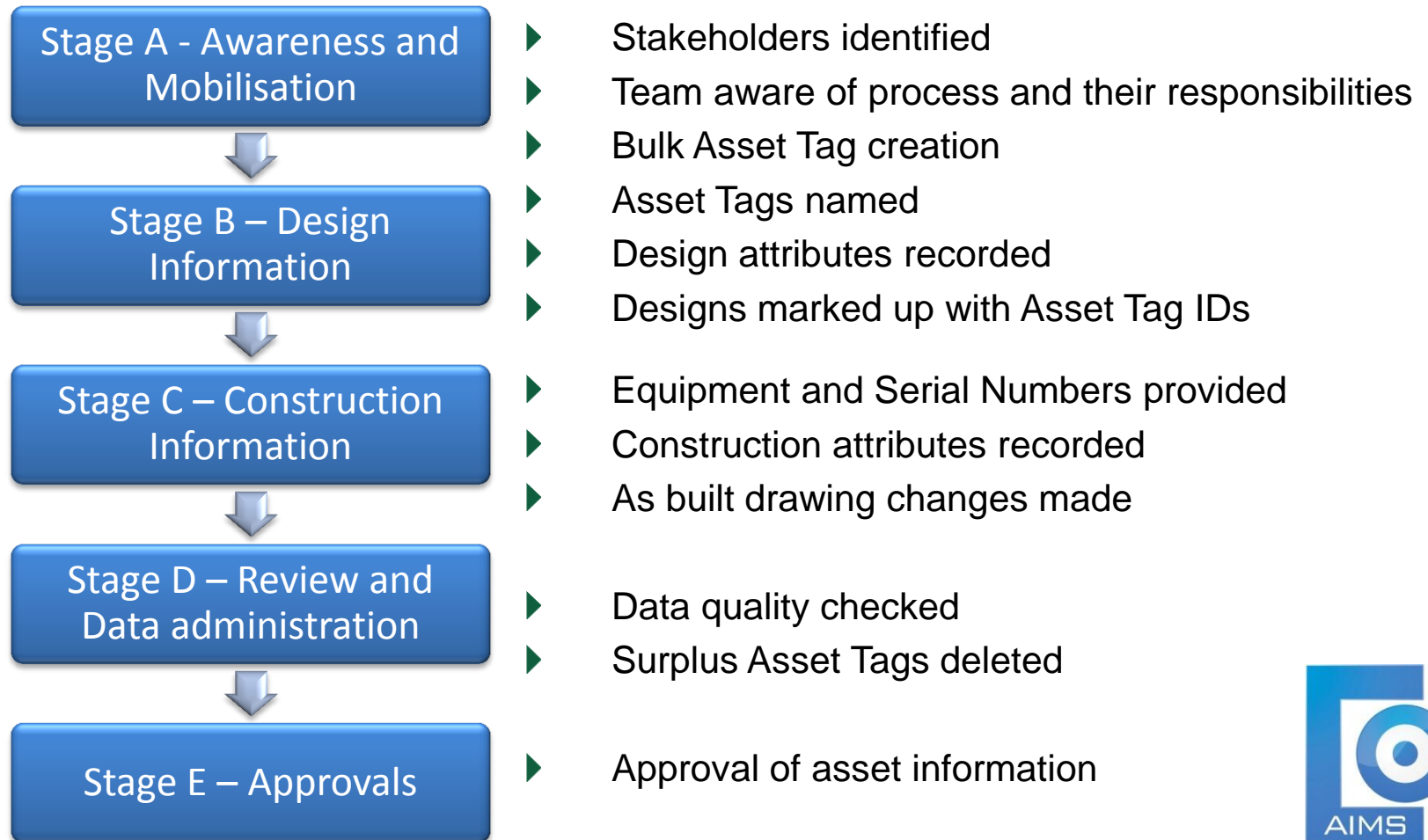
Asset Information Contract Clauses



Part 13 – Assurance, Records and Certification.....	1
13.1 Introduction	1
13.2 Assurance	1
13.3 Deliverables and Records	2
13.4 Certification to be Provided	6
13.5 Asset Management & Traceability	8
13.6 Critical Readiness Review	10
13.7 Appendices	11
Part 14 – Management and Administration	11



What's the Procedure?





Station Scanning

Trimble Webshare

The screenshot displays the Trimble Webshare interface for station scanning. The browser address bar shows the URL: `172.18.149.121:8400/DebugTomcat/WebScene/WebScene.html?autoLoad=&scanID=&rotationX=&rotationY=&zoom=&dialog=`. The interface includes a sidebar with the following sections:

- Project:** Crossrail Canary Wharf Station
- Scan Details:** Scan001
- Recording Time:** 30.07.2013 - 12:06:02
- Last Modified:** 30.07.2013 - 11:52:29
- Settings:** Unit of length: m, Unit of area: m²

The main content area features a 3D point cloud model of the station interior. The model shows a large, open space with a high ceiling and structural elements. A red dot on the model indicates a specific point with coordinates: $X_i = 6.107 \text{ m}$ and $Y_i = 7.486 \text{ m}$. A scale bar on the right indicates 4.0 m. The bottom portion of the interface shows a live video feed of the station interior, where workers in high-visibility vests are visible near a construction area.



Smart Railway

SERVICE



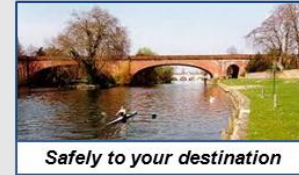
Predictable 24/7



Seamless - Stn to train



Comfort



Safely to your destination

A responsive, efficient, flexible railway that adapts to variations in demand and perturbations

PEOPLE



Customer Service



Operations & Control



Asset Technicians

Engaged motivated, valued people with tools to diagnose, predict and advise

User Applications

Central Data Hub



Asset Information

Intelligent Assets that manage themselves and require minimal human intervention

ASSETS

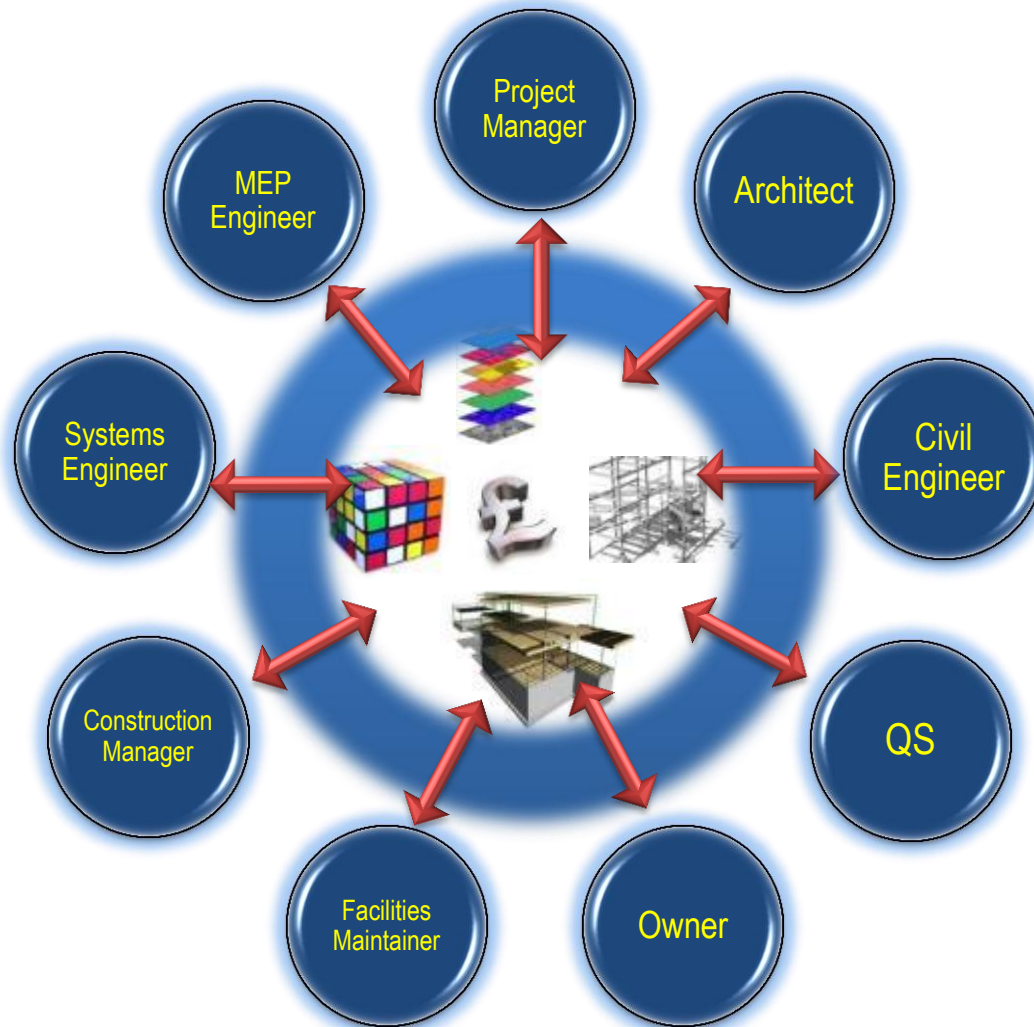
Stations

Rolling Stock

Infrastructure

◀ BIM in Asset Management

◀ Role of Crossrail – “Enabler” of BIM



Embracing new technologies:

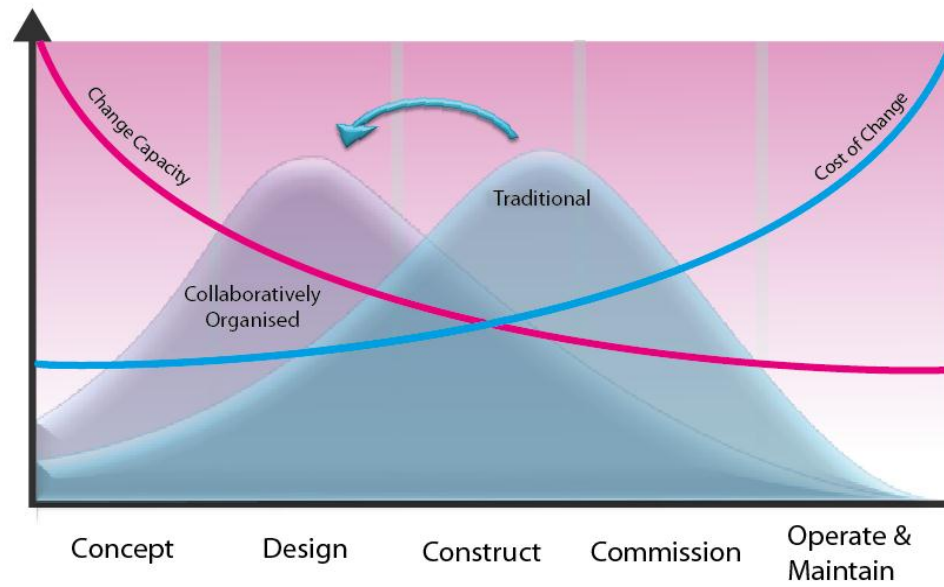
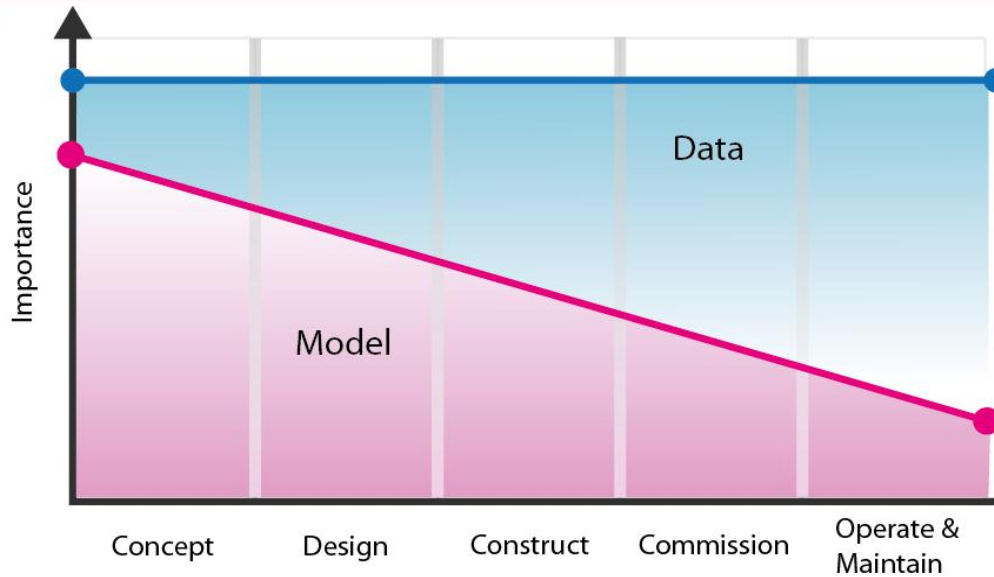
.... the process of generating and managing building information during its life-cycle.

.... model-based technology linked with project information databases.

....a common data environment.

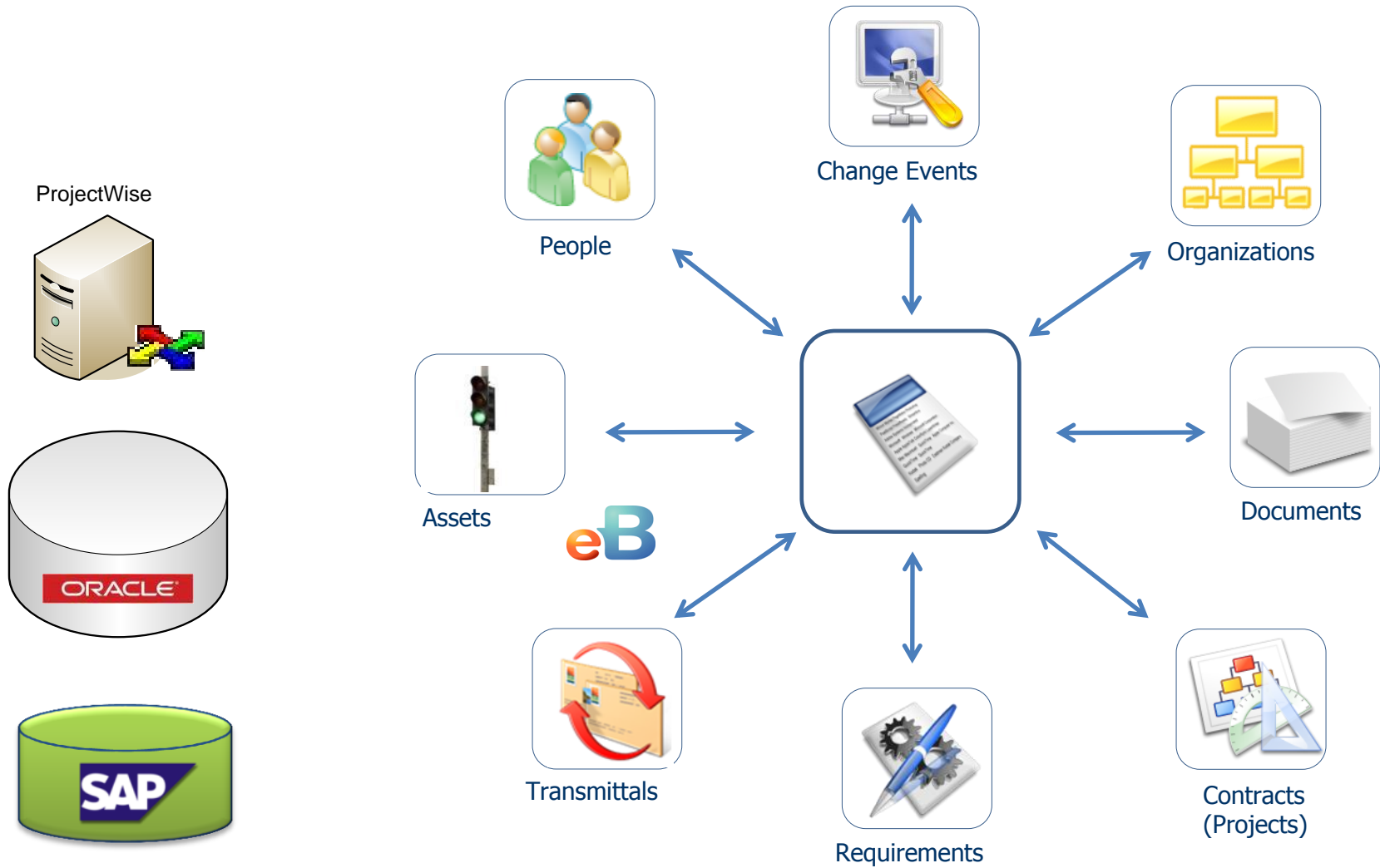


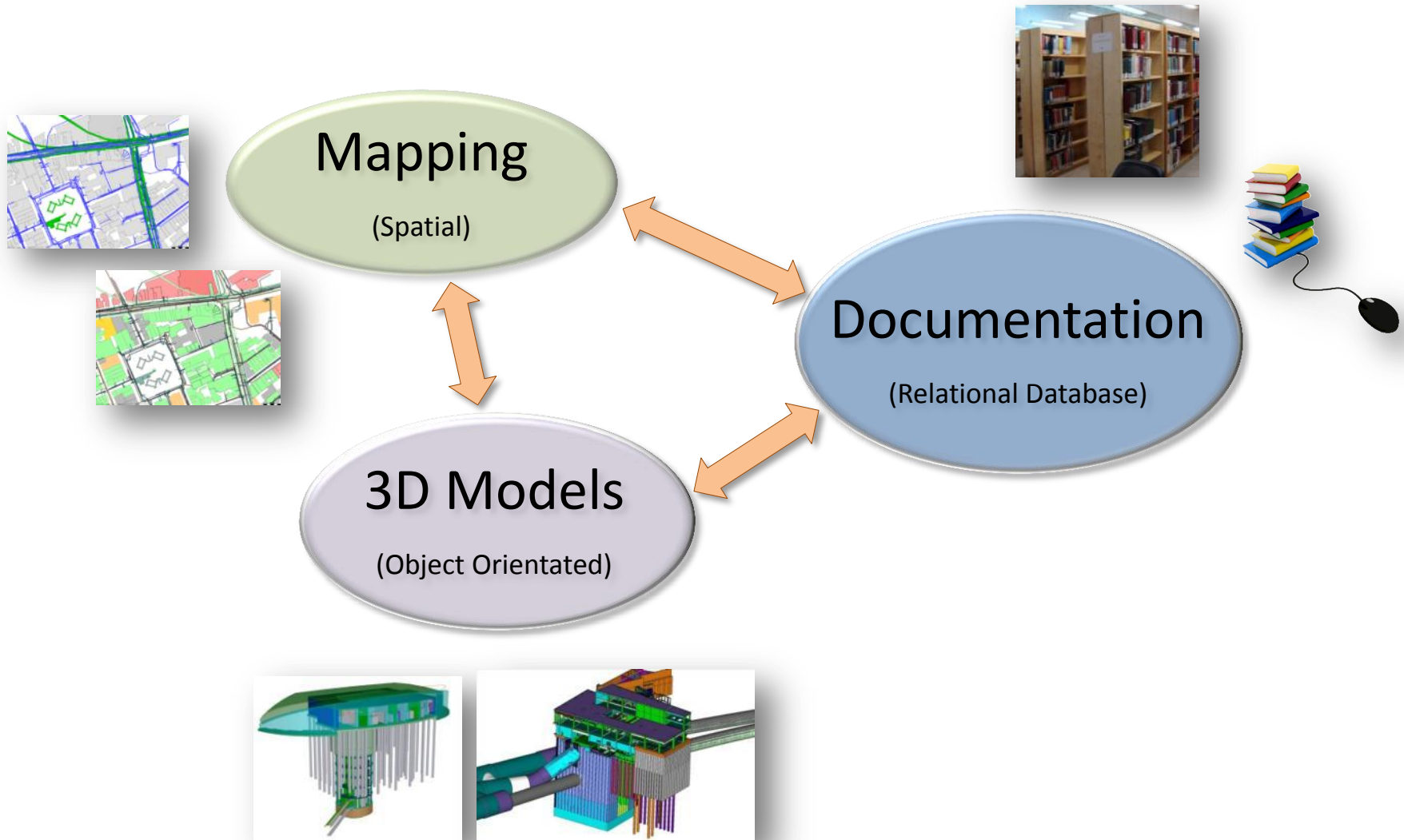
First Principles....





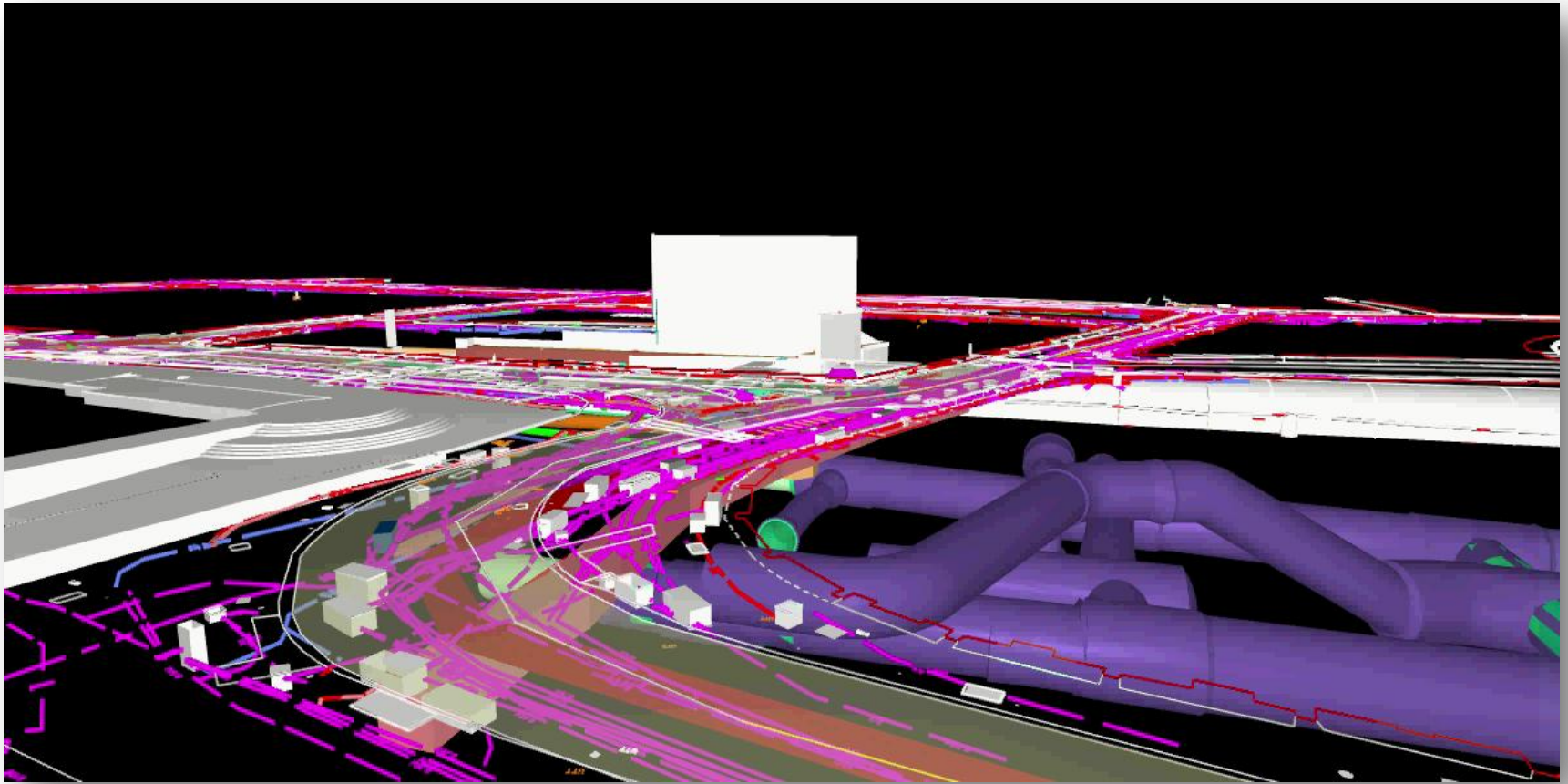
Storing Information





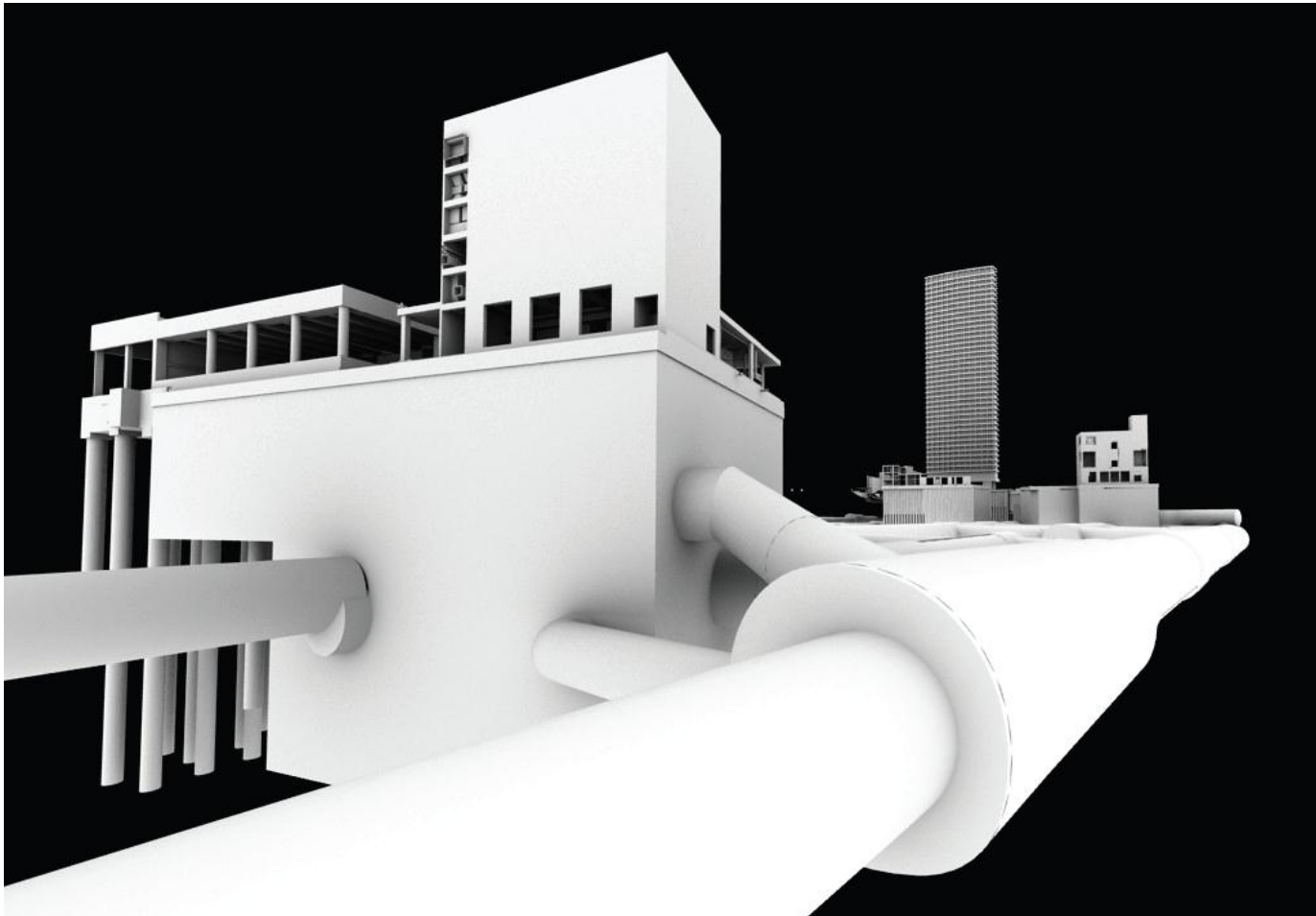


BIM & Utilities



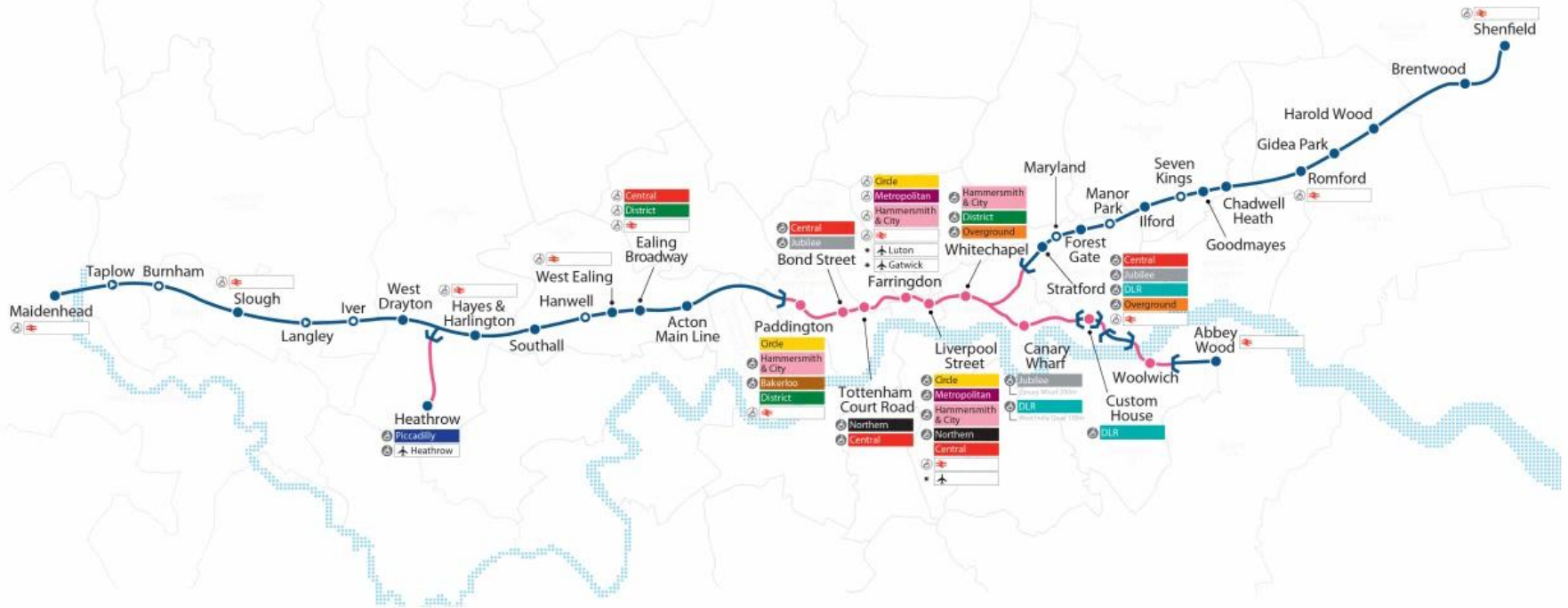
3D Information Models

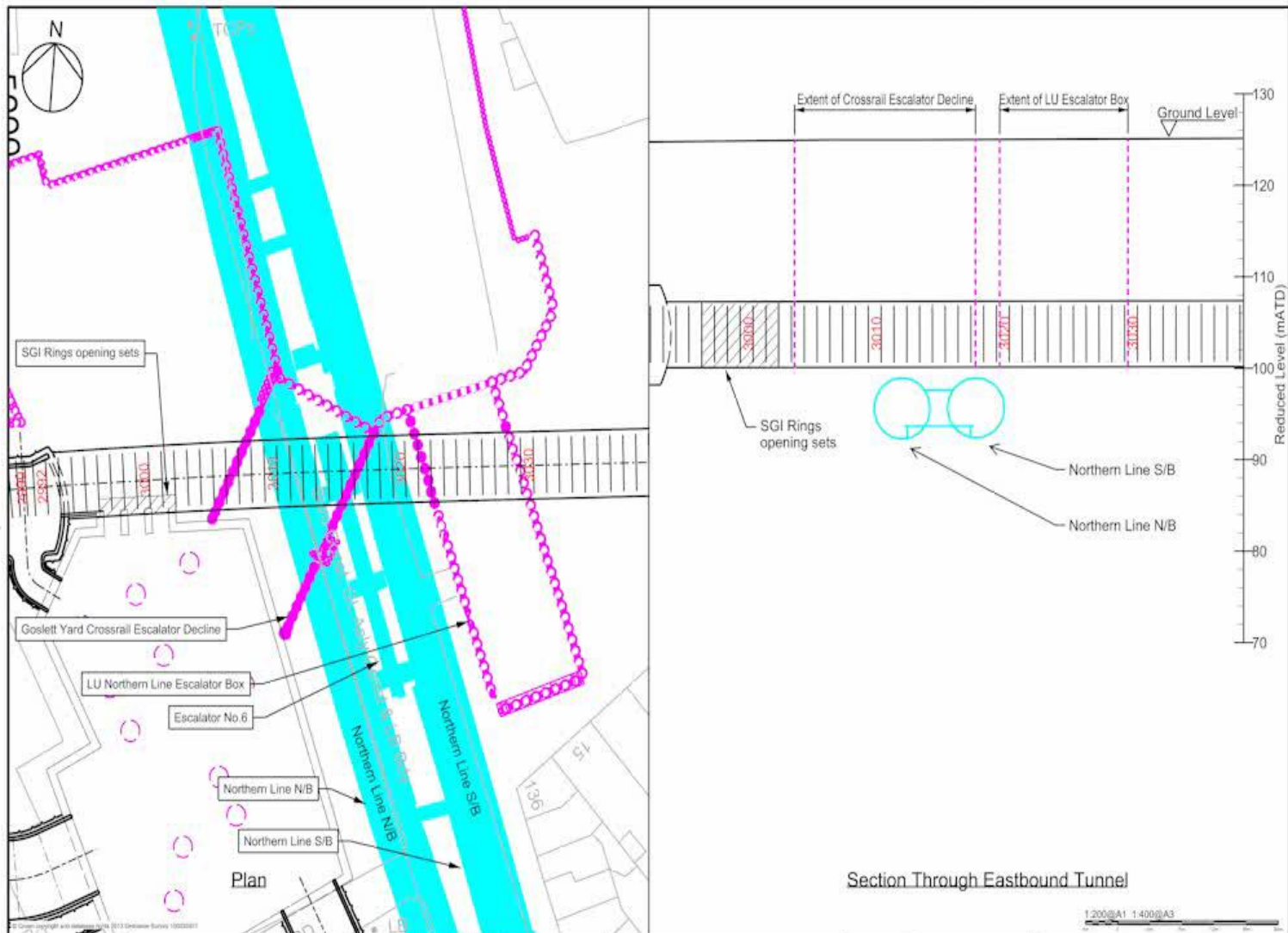
Tottenham Court Road Station





Managing Interfaces





<p>© Crown Copyright and database right 2017 Ordnance Survey 100029171</p>	<p>30/06/2017</p> <p>1:200@A1 1:400@A3</p>
--	--

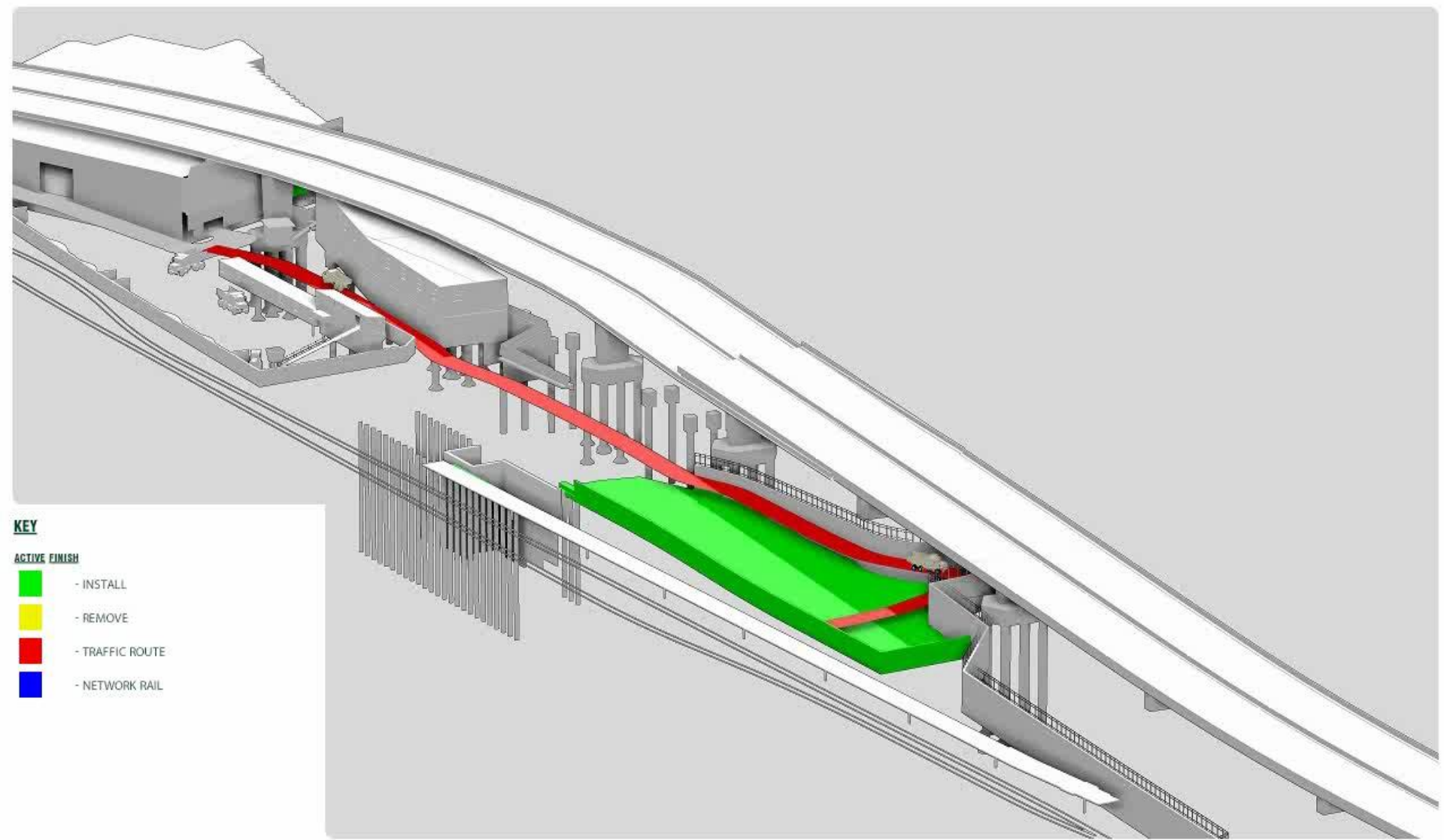
<p>Legend</p> <p>Northern Line Lines</p> <p>Structures</p>	<p>Scale</p> <p>1:200@A1 1:400@A3</p>
--	---------------------------------------

BFK
Bentley | Fenwick | Idder

BFK Joint Venture
Site Office
Great Western Road
Exeter
EX1 3JY

Crossrail

<p>C300C410 Western Running Tunnels and Station Cavemas</p> <p>BFK Joint Venture</p> <p>Tottenham Court Road</p> <p>Eastbound TBM</p> <p>Northern Line - Platform Tunnel</p> <p>TBM 2 Crossing</p>	<p>© Crown Copyright and database right 2017 Ordnance Survey 100029171</p> <p>1:200@A1 1:400@A3</p>
--	---



- KEY**
- ACTIVE FINISH**
- INSTALL
 - REMOVE
 - TRAFFIC ROUTE
 - NETWORK RAIL

VIEW A

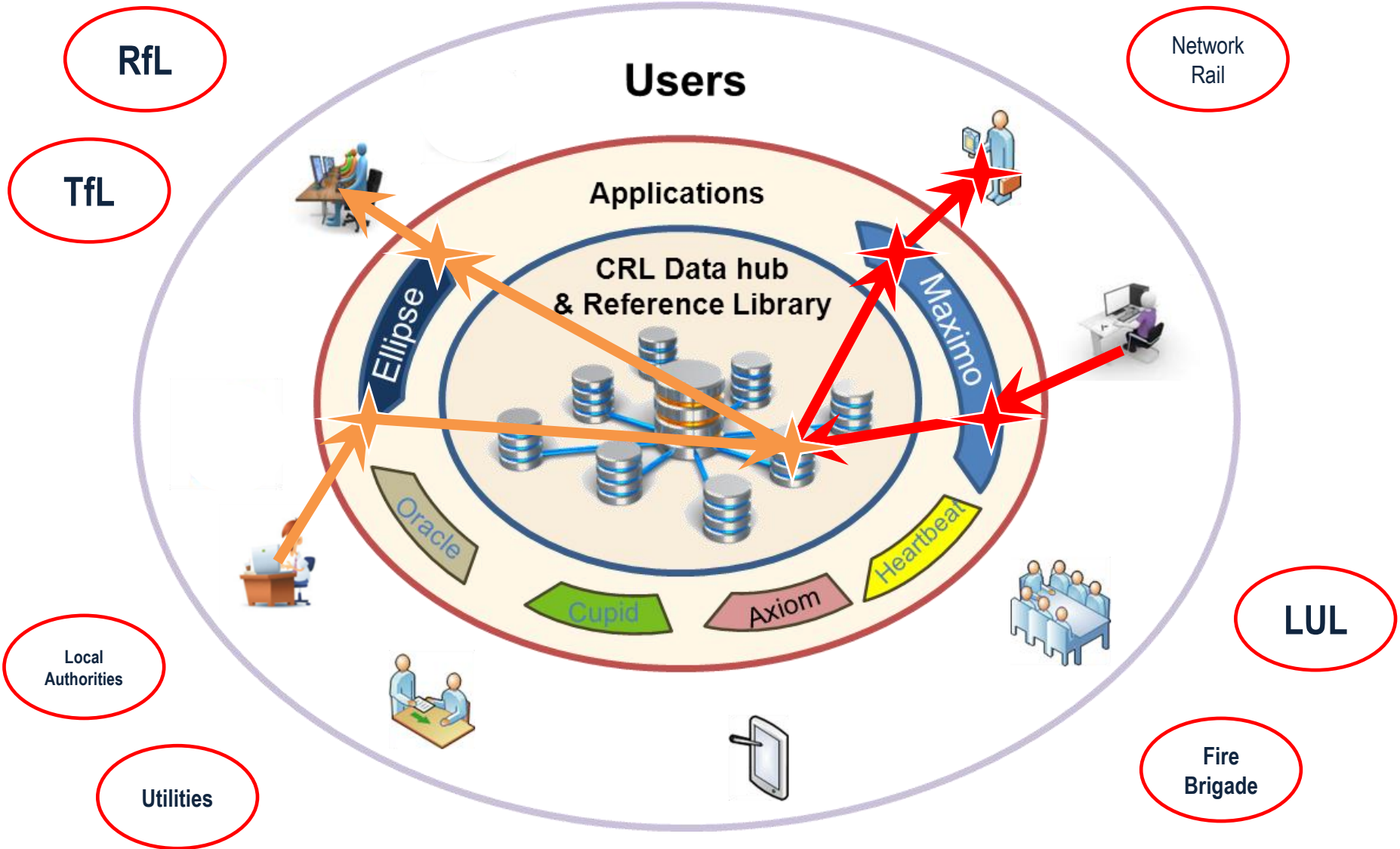


Delivering the Asset Model



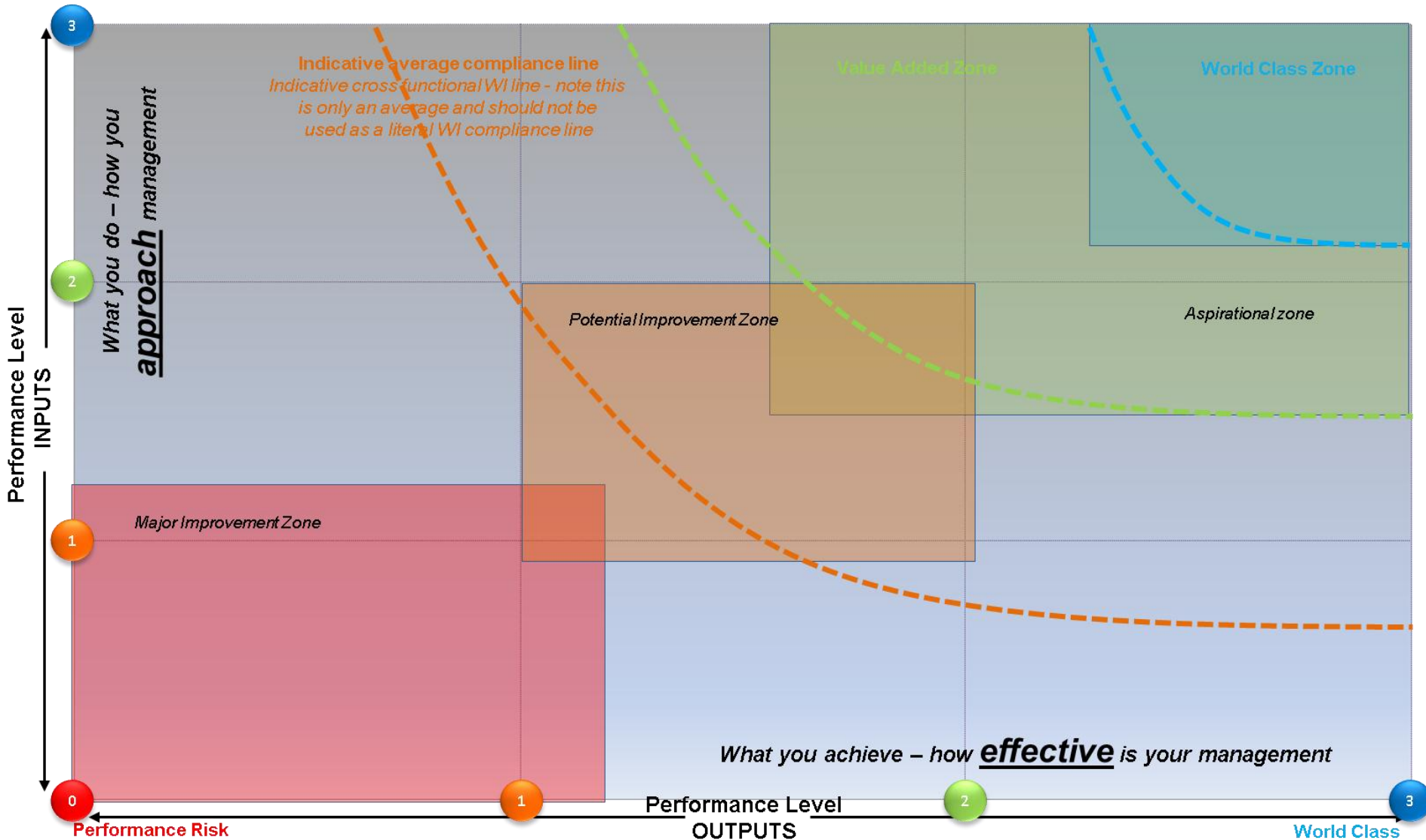


Railway Data Hub



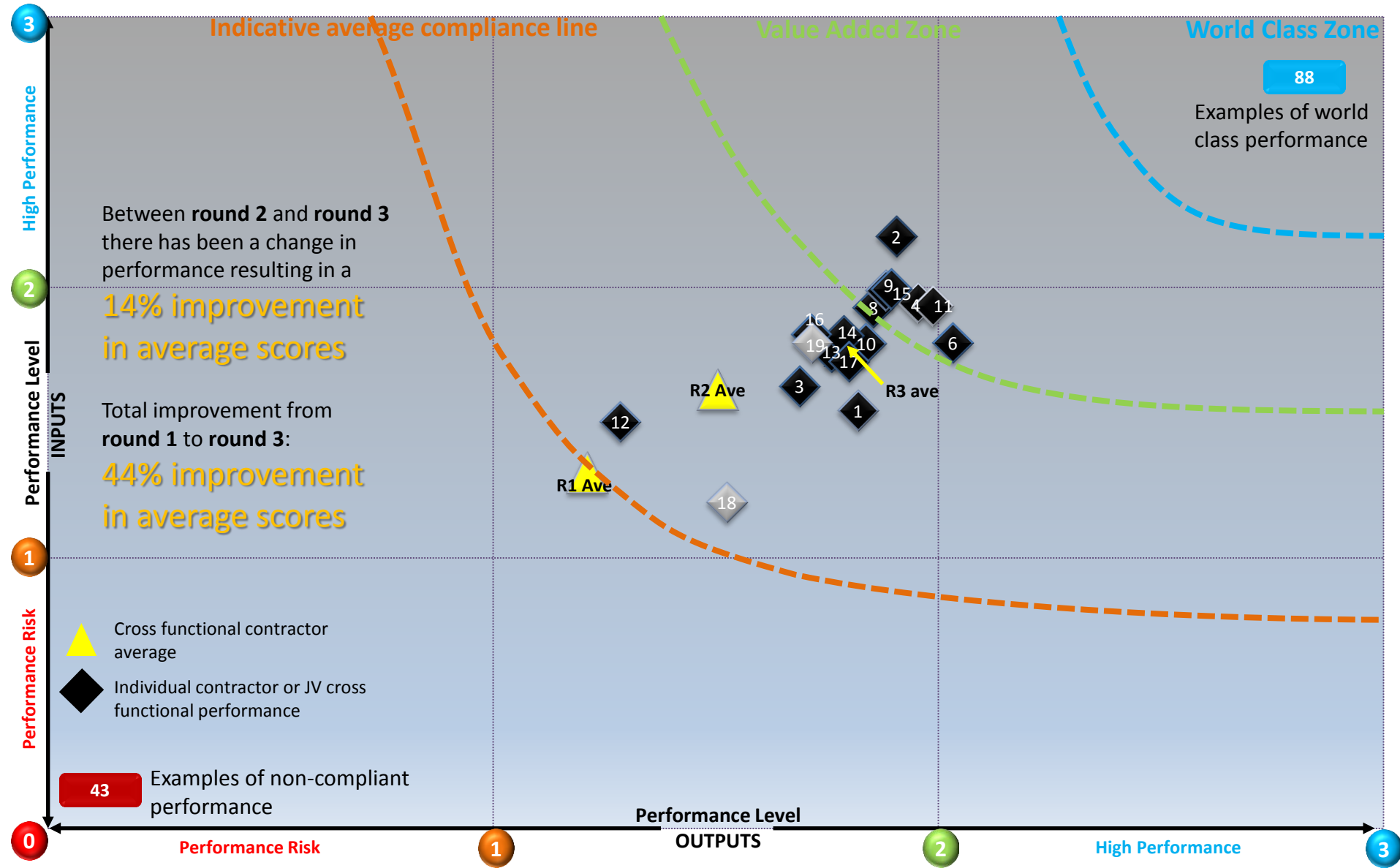


Performance Assurance Scoring





Performance Assurance Scoring



◀ Innovation





Innovation Programme Objectives

- ▶ To draw up and share innovation already happening within Crossrail
- ▶ Identify challenges and collaborate to find innovative solutions
- ▶ Develop innovations that will raise the bar across industry



Imperial College
London



OUR VISION

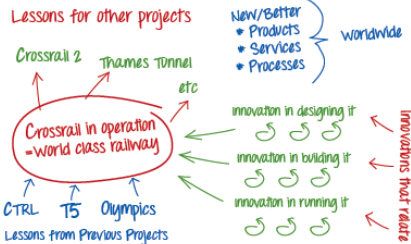
Crossrail has broken the mould in UK construction by being the first organisation to develop a strategy and process for managing innovation in mega projects. Some of the UK's previous mega projects (e.g. High Speed 1, Heathrow Terminal 5 (T5) and the London Olympics 2012 construction) have taken important steps to institutionalise innovation in mega projects. However, efforts have often been informal and lessons have not been fully captured. Previous projects focused on creating novel approaches to project delivery (e.g. BAA's T5 Agreement) rather than establishing a process to promote innovation within and beyond the life of the project.

Open models of innovation provide a toolbox better suited to tackling the challenges which have historically made the management of innovation so difficult in mega projects. Our open approach views the mega project as an 'ecosystem' of many diverse and interconnected

organisations. It focuses on building the organisational mechanisms and culture required to broker innovation between the different parts of this ecosystem.

- Figure 1 shows our vision for an innovation strategy at Crossrail including processes that:
- Generate, develop, codify and formalise innovation in Crossrail's design, construction and handover to operations
 - Benchmark and measure innovative improvements
 - Capture and transfer lessons to future projects

Figure 1. Crossrail's Innovation vision



OUR POLICY

Crossrail's innovation policy is a statement of intent and commitment to fostering, nurturing and incentivising innovation across the programme.

It consists of a statement of purpose, the policy's applicability and scope, the responsibility for delivering it, and clear principles to guide innovation investment.

decisions. The policy has been tightly aligned with Crossrail's values of safety, inspiration, collaboration, respect and integrity.

THE 3Cs

Collaboration, Culture and Capability (shown in Figure 3) are the three key enablers fostering innovation across the Crossrail programme.

COLLABORATION

Crossrail is driving innovation by building effective collaboration among partners in the supply-chain, including universities, railway operators, users and other stakeholders. Collaboration among

partners varies depending on whether participation is open or closed, and whether governance is hierarchical or flat.

Crossrail has established a new governance structure, the Crossrail Innovation Forum, to help drive the collaboration required to execute its strategy. Collaboration consumes resources and budgets. Developing a funding model in collaboration with Crossrail's partners is essential. This funding

model is not firm stakeholders but access resources funded by government (Engineering and Research Council Strategy Board)

- The key element of collaboration organisations are:
- Partnering
 - Funding
 - Intellectual Property
 - Governance

'Nurtured from the top-down, grown from the bottom up'



'We can't tender innovation, it requires partnership'

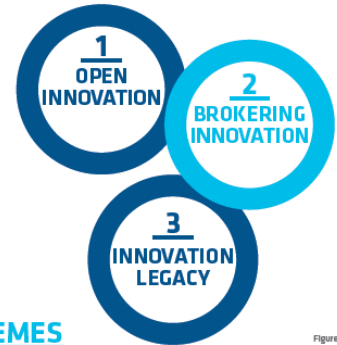
'Building into existing external complementarity'

Figure 3. The 3Cs of Innovation

METHODS

Figure 7 shows three connected and mutually reinforcing methods or processes to promote innovation in the Crossrail programme. The three methods are sequential.

1. Open Innovation: to connect and develop novel ideas with external communities
2. Brokering Innovation: to capture, coordinate and replicate innovation within and across the programme
3. Innovation Legacy: to articulate and codify lessons for future projects



THEMES

Crossrail has identified three fundamental themes to provide direction.

These are:

- Delivering efficiencies through the life cycle
 - BIM
 - Safety
 - Design for manufacturing, assembly and operations
 - Integrated systems
 - Asset management
- Digital-physical integration
 - Smart Technologies
- Sustainable solutions
 - Economic
 - Social
 - Environment

Figure 7. Methods of Innovation

Safety Glove Messages



SKANSKA



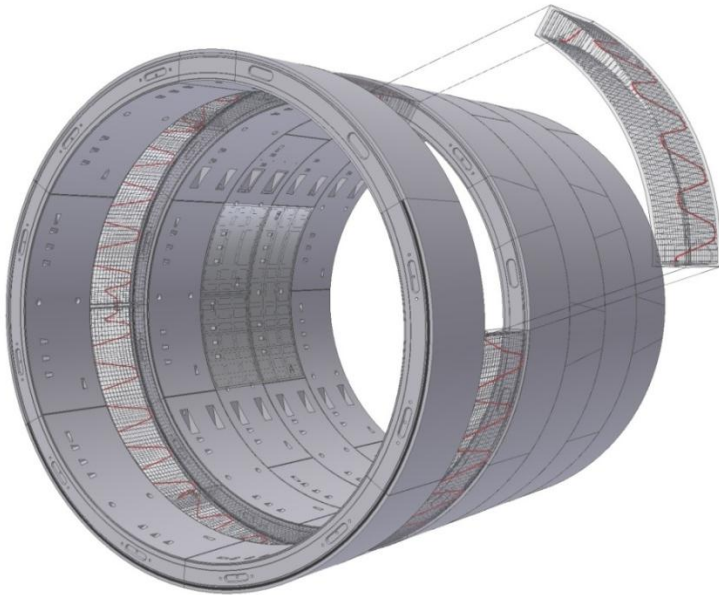


Smart Construction in Practice

Tunnel Energy Segments



Rehau Ltd



Ultra Low Carbon Concrete



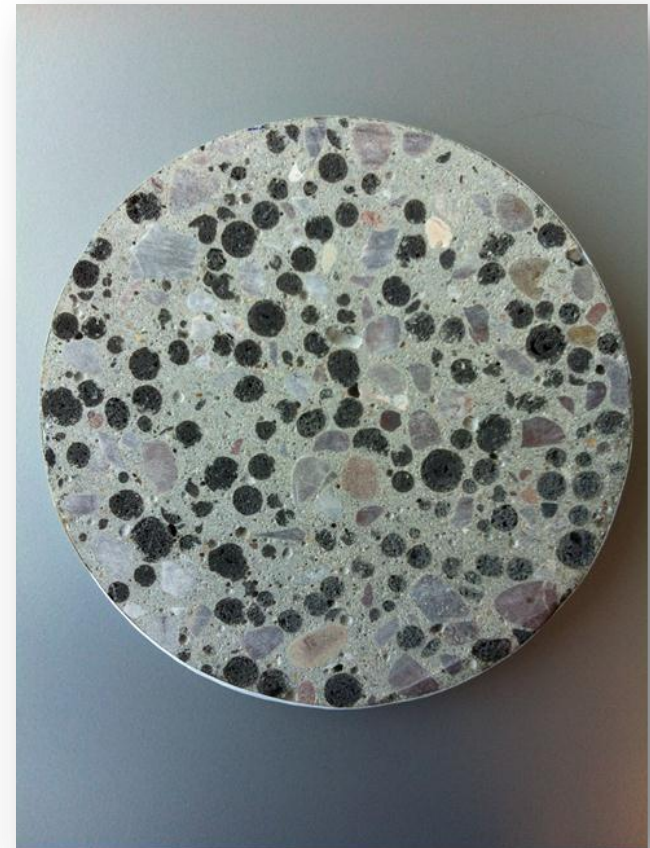
David Ball
Group plc



Light Weight Aggregates



Nustone Ltd



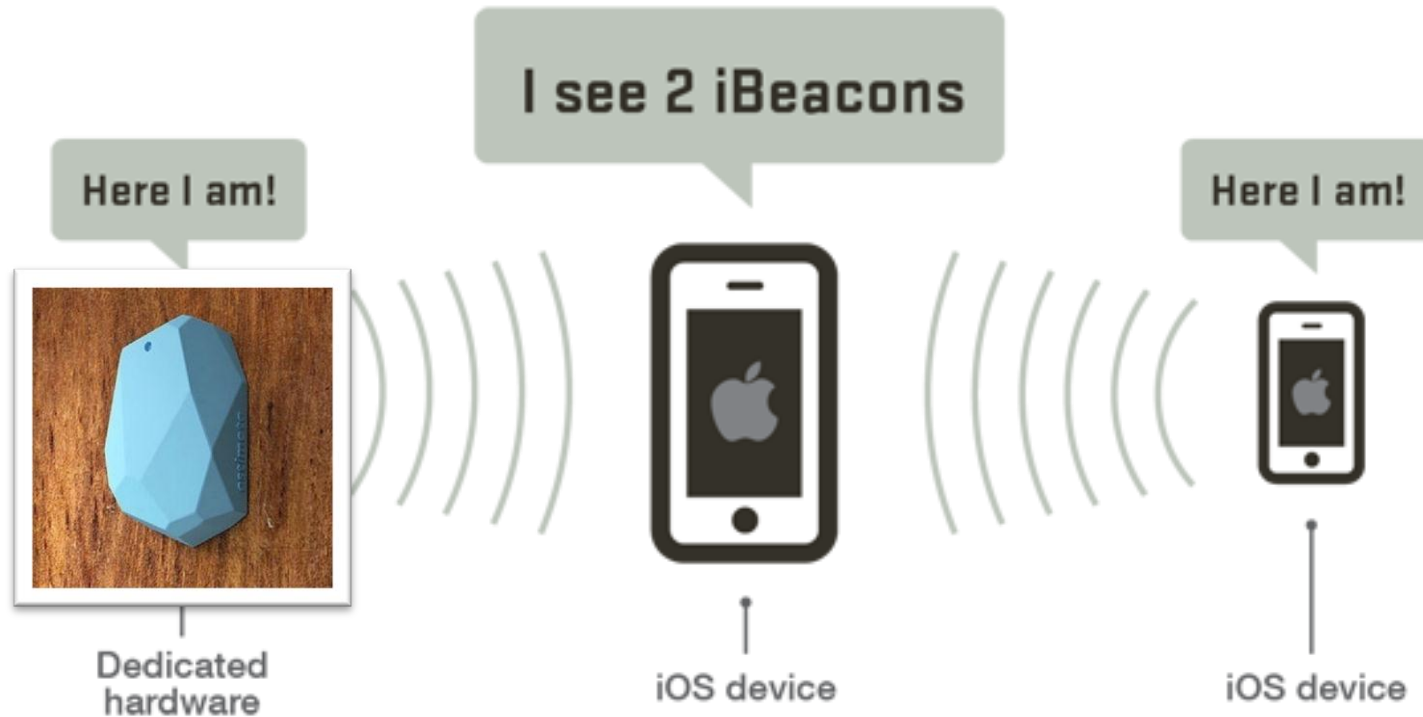


Smart Construction in Practice

Bluetooth Low Energy Beacons



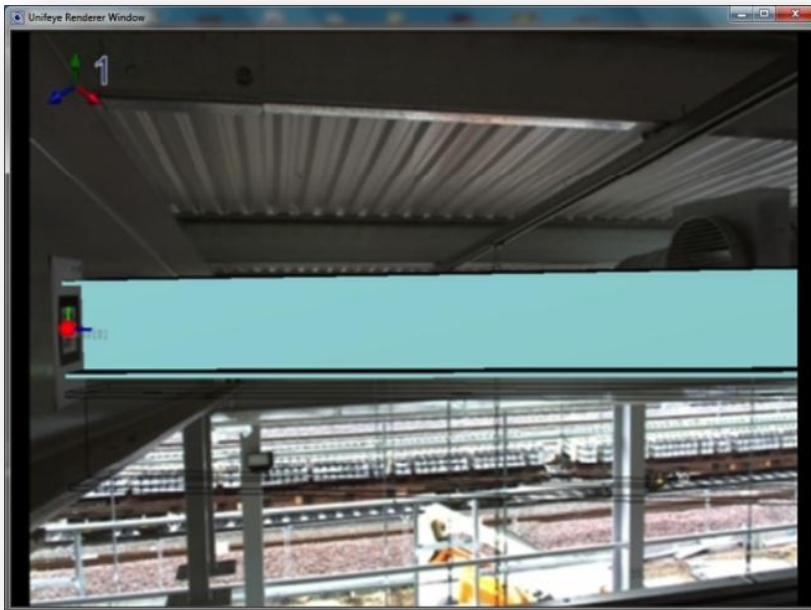
A STATE OF MIND

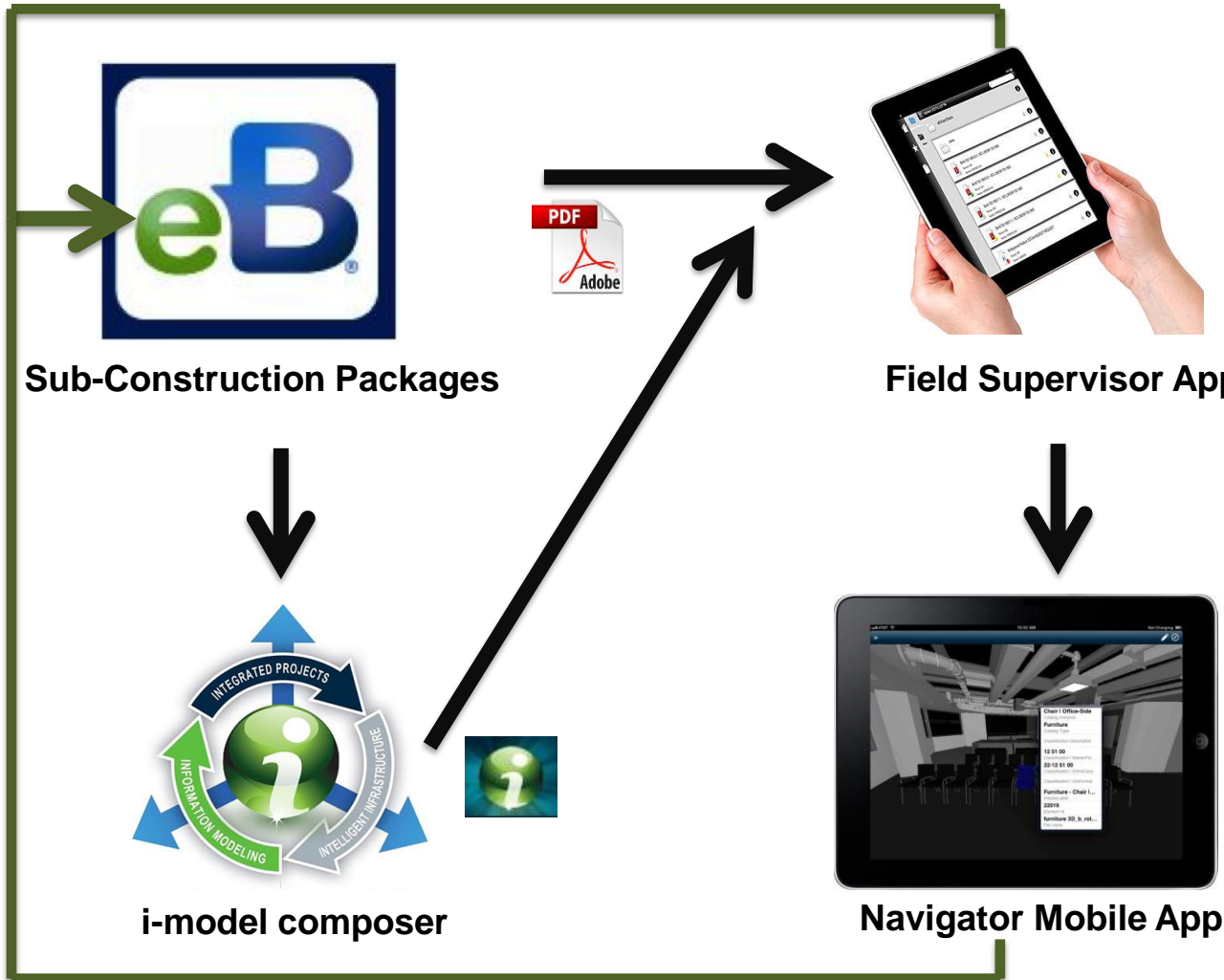




Smart Construction in Practice

Augmented Reality





Access to

- construction packages - drawings, specs, ITP's
- Forms to make field notes
- Annotate/red line documents

Access to

- construction packages – 3D Model View
- Filter model by attribute
- Annotate/red line model
- Construction status updates in model



Augmented Reality

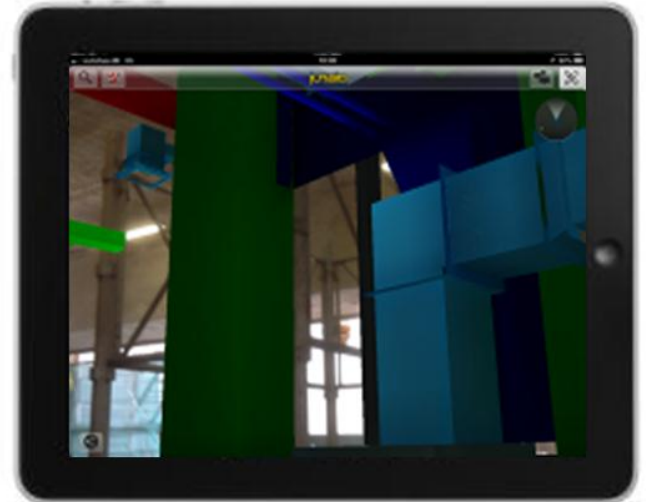
Access to

- ▶ 3D Model
- ▶ Line-of-site & location specific data in real-time

Update

- ▶ As Built records
- ▶ RFI's

... All Managed Electronically





Thank you!

