

# CROSSRAIL: MOVING BIM FORWARD

How Crossrail is using BIM through the design, construction, operations and maintenance of the railway

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Crossrail Ltd



**MOVING LONDON AND BIM FORWARD**

# Agenda

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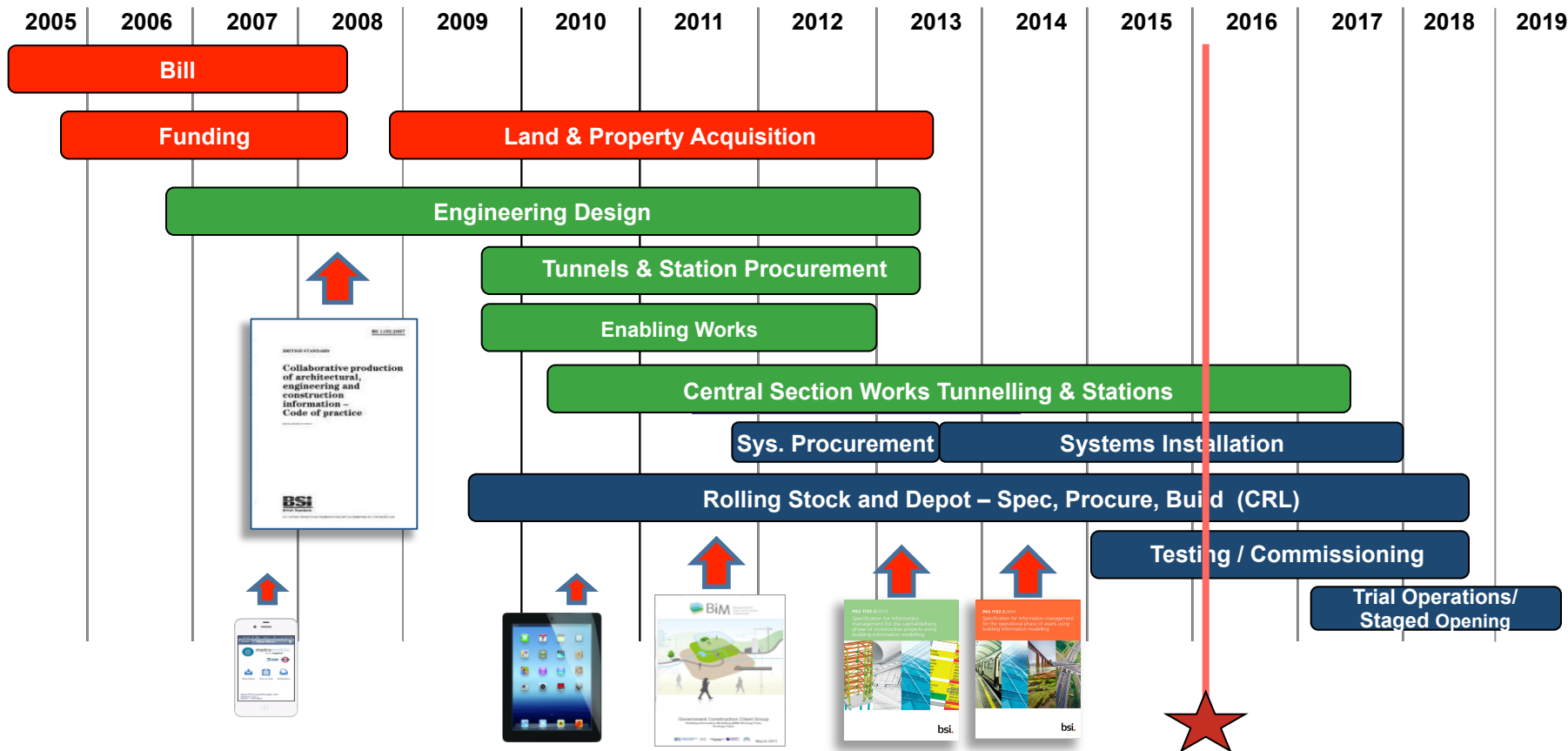


- Crossrail overview
- What is BIM?
- BIM in:
  - Planning
  - Design
  - Construction
  - Operations & Maintenance
- Benefits



1 World Class Railway

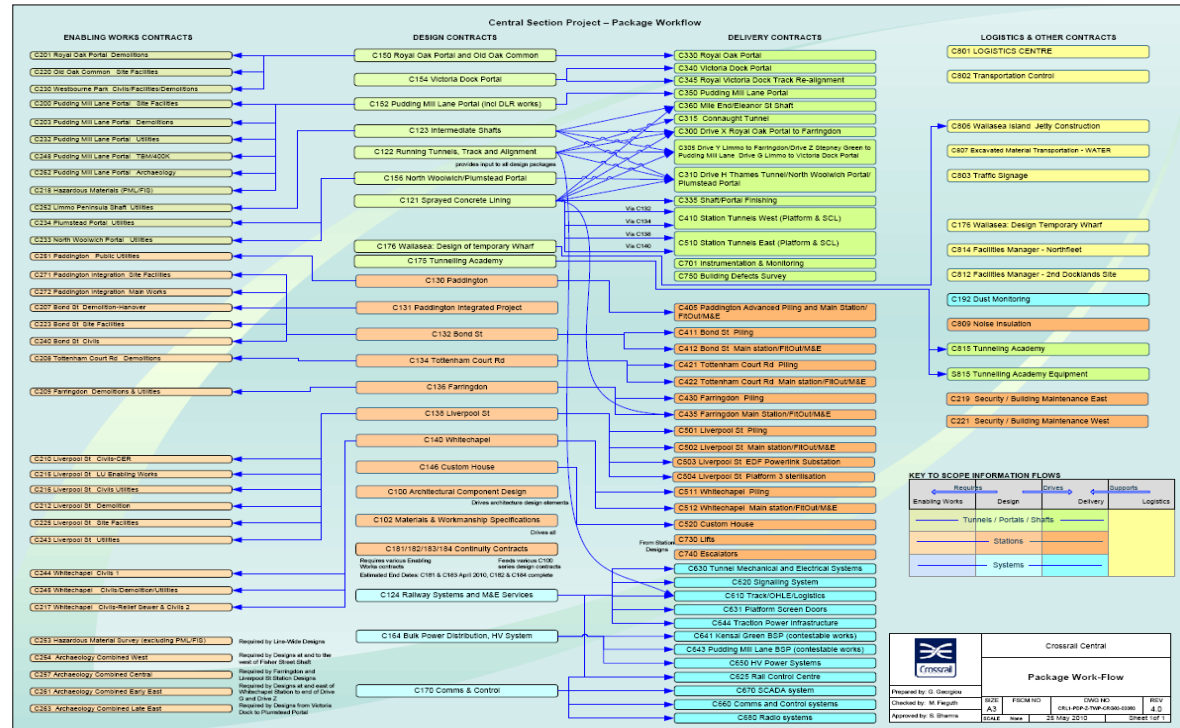
# Programme



# Contractual Complexity

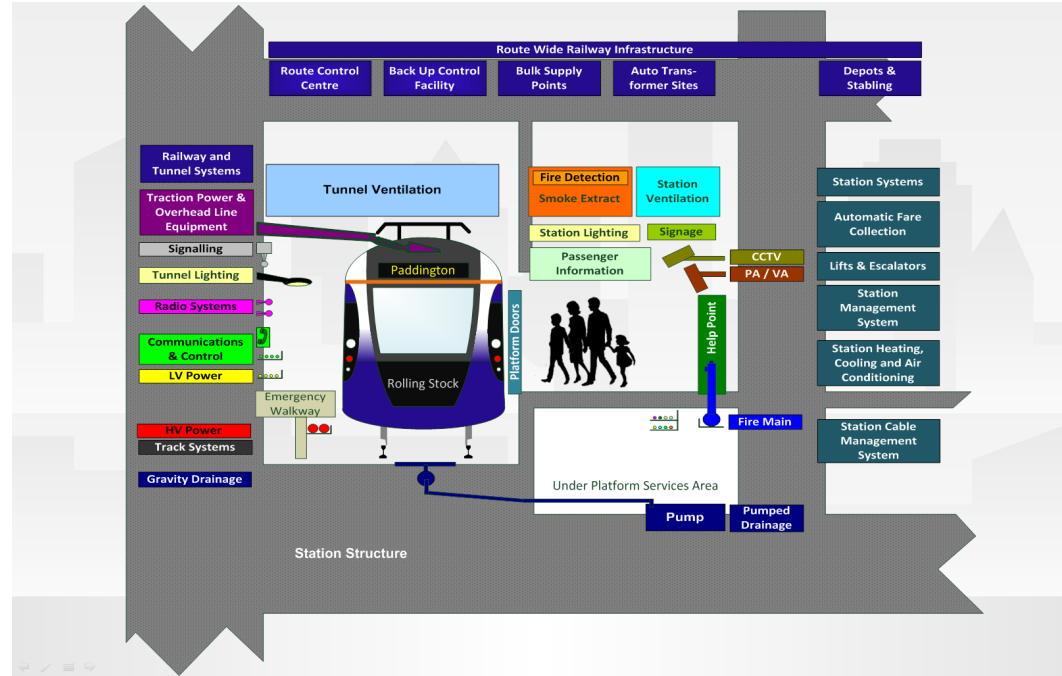


- 34 Enabling Works Contracts
- 23 Design Contracts
- 45 Delivery Contracts
- 14 Others



# Technical Complexity

- Multiple Disciplines
- Multiple Interfaces
- Shared Spaces



# What is BIM?





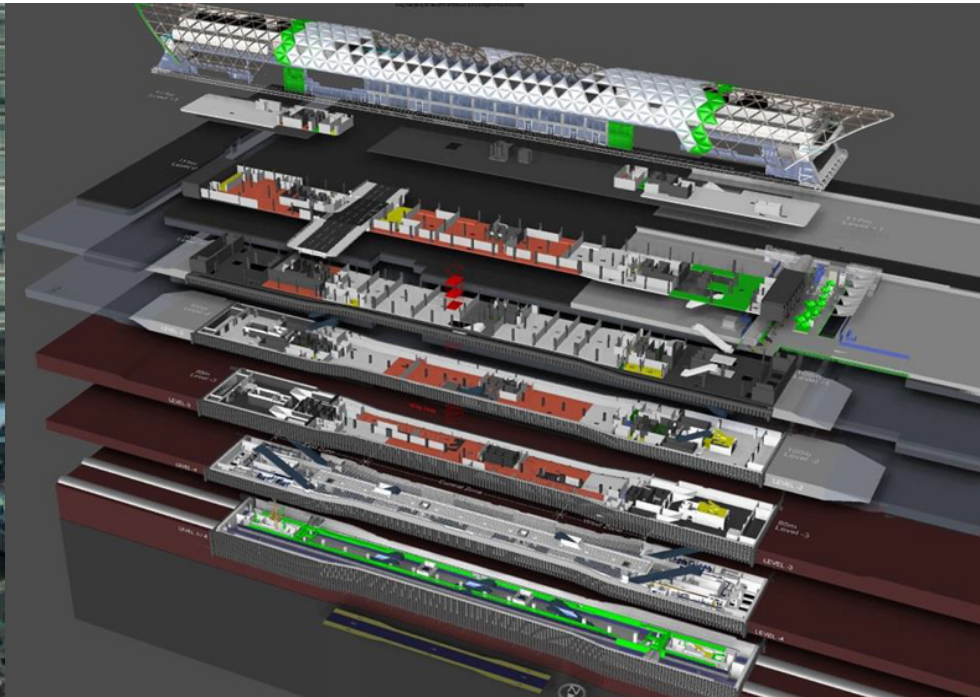
# Building Two Railways



Physical



Digital

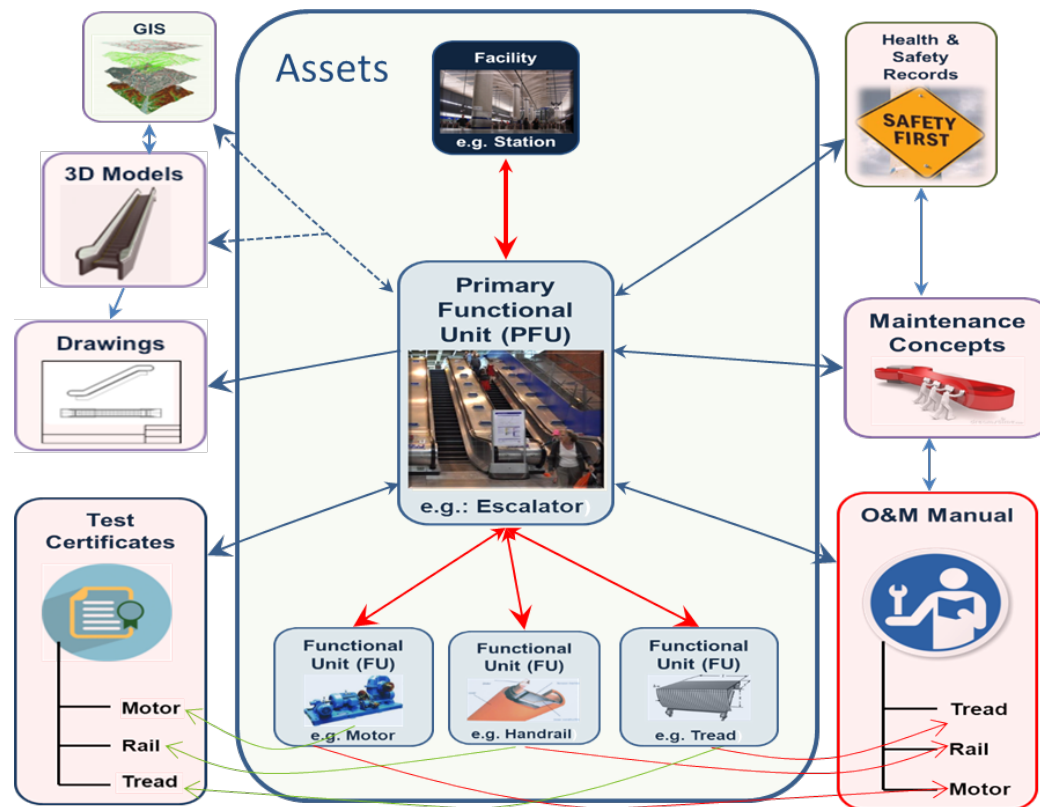


# Key Characteristics

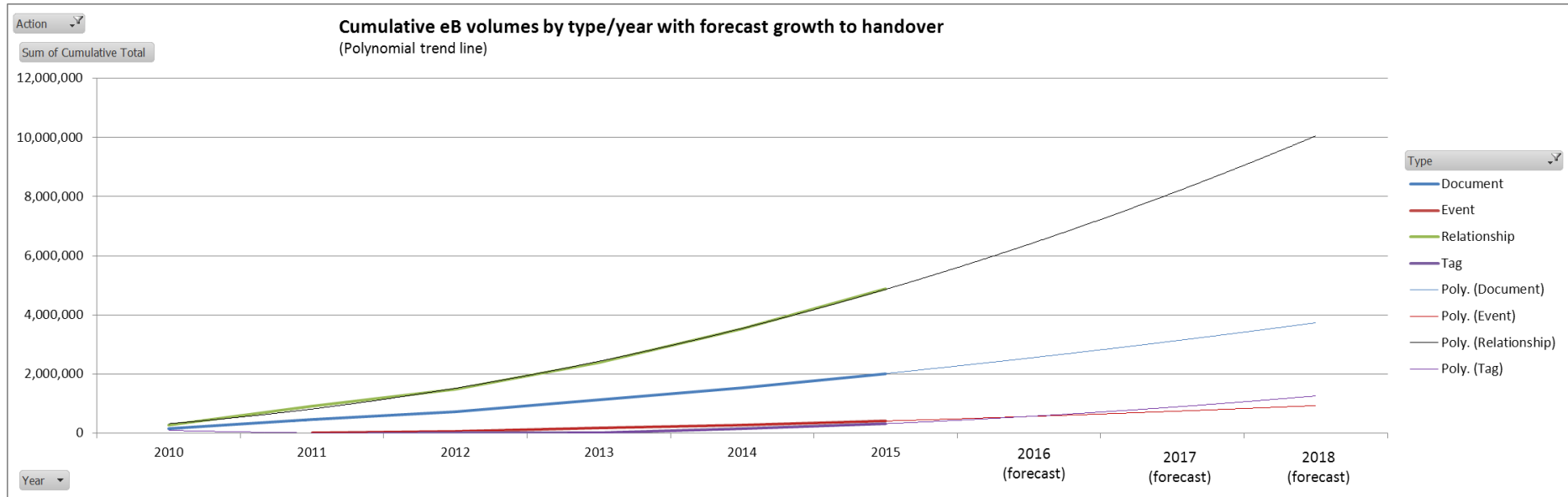


## The Environment

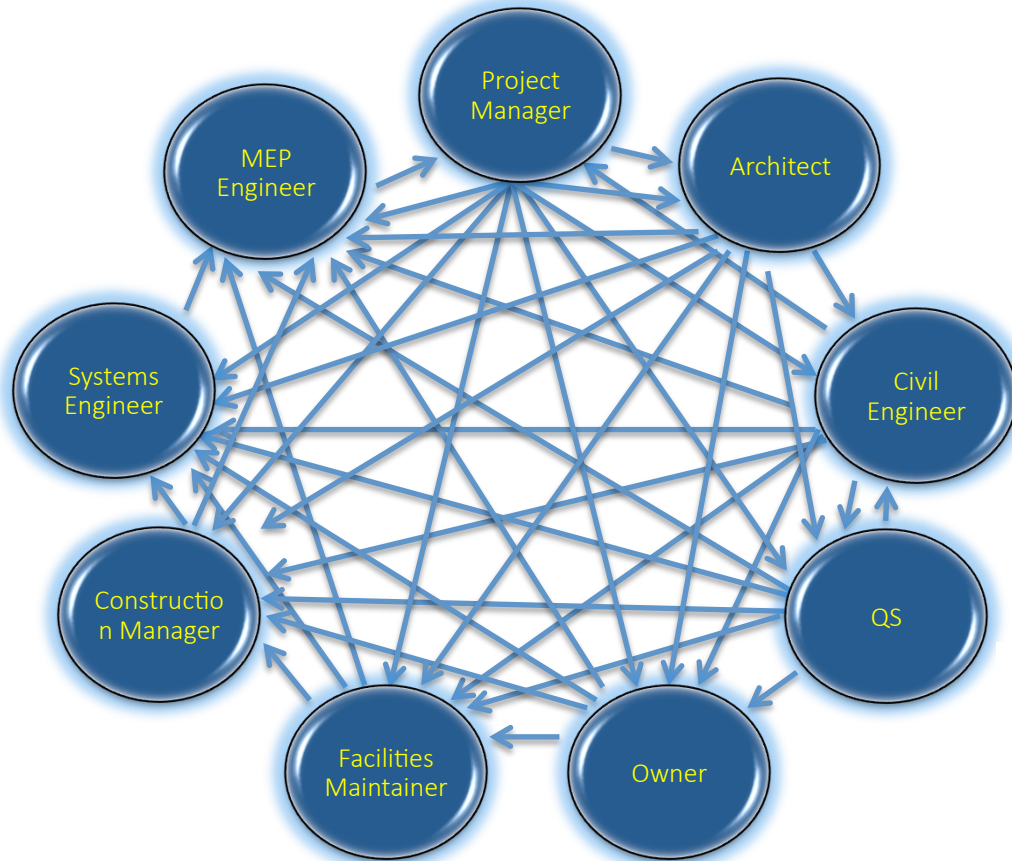
- A defined end-game for data
  - Information requirements set out
  - Classifications and data structure
  - Procurement critical
- A Common Data Environment (CDE)
  - EDMS and ECMS
  - Used by everyone
  - Owned and managed by the Client
- BS/PAS 1192
  - Roles, deliverables and processes



- Plan your information needs through the life cycles e.g. the CRL data store

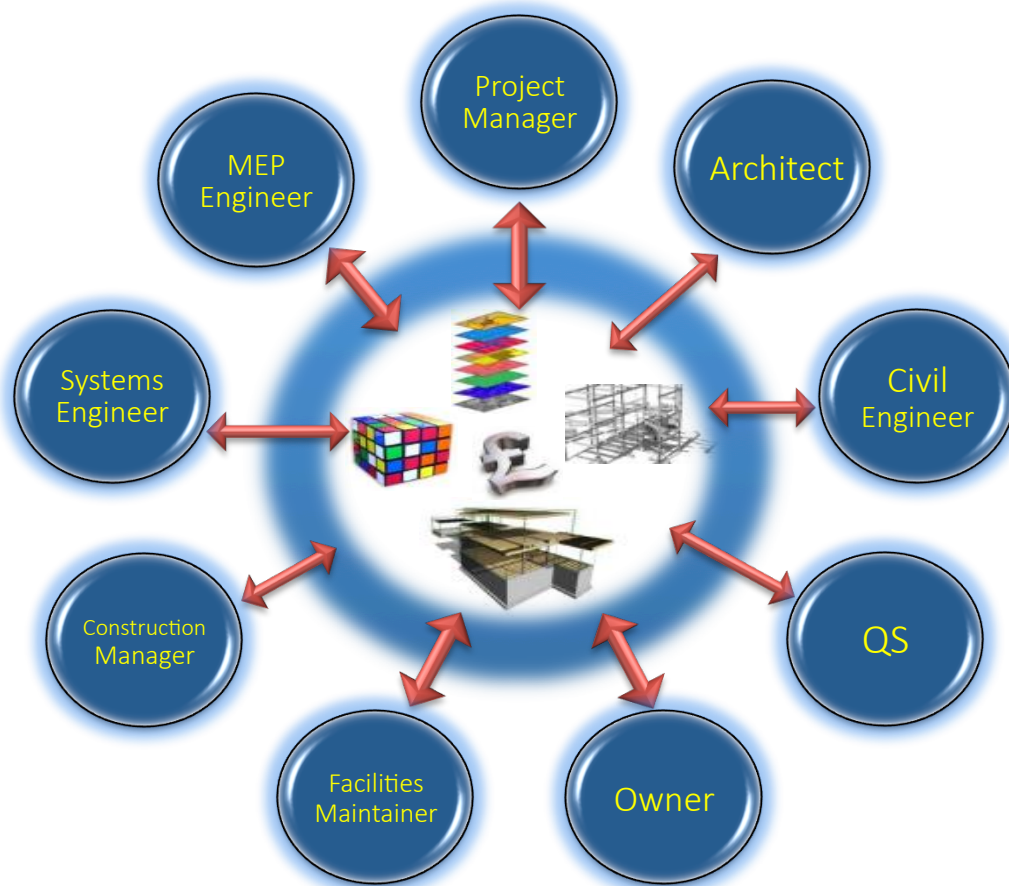


# Project Delivery Originally



A reminder of  
the old world...

# 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.



# BS1192 informed Data Environment



BS 1192:2007

BRITISH STANDARD

## Collaborative production of architectural, engineering and construction information – Code of practice

ICS 01.100.30: 35.240.10

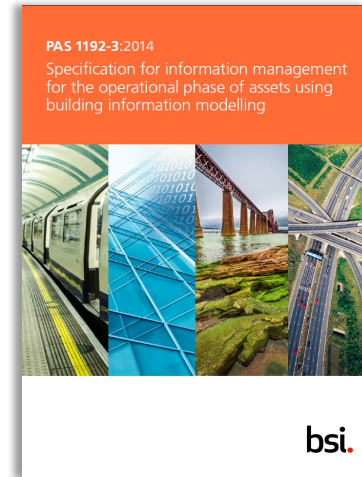


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## BS 1192

The methodology for managing the production, distribution and quality of construction information throughout the project life-cycle and supply chain.

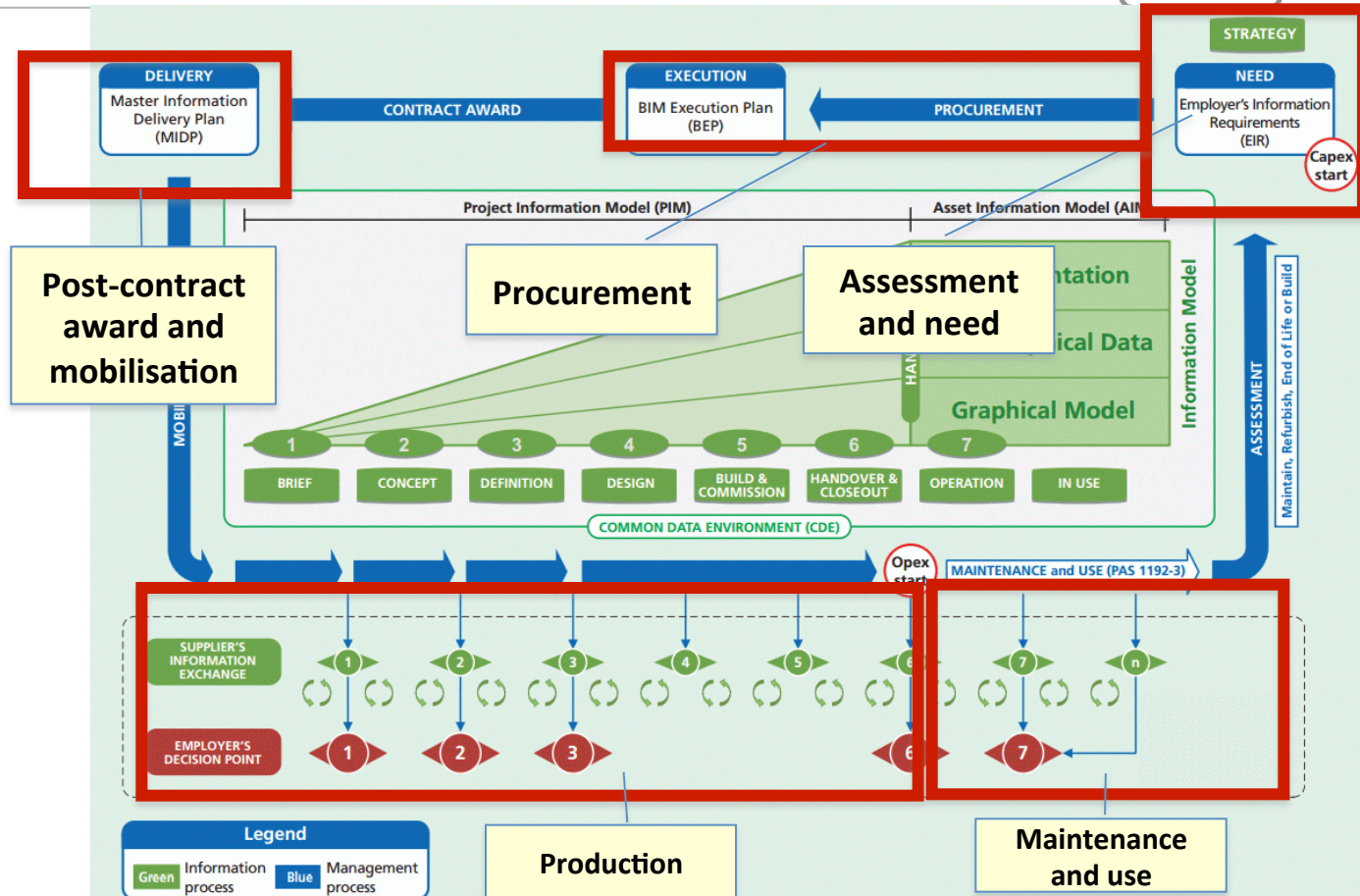


# Process

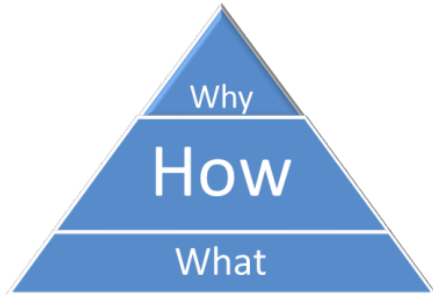


## Requirements

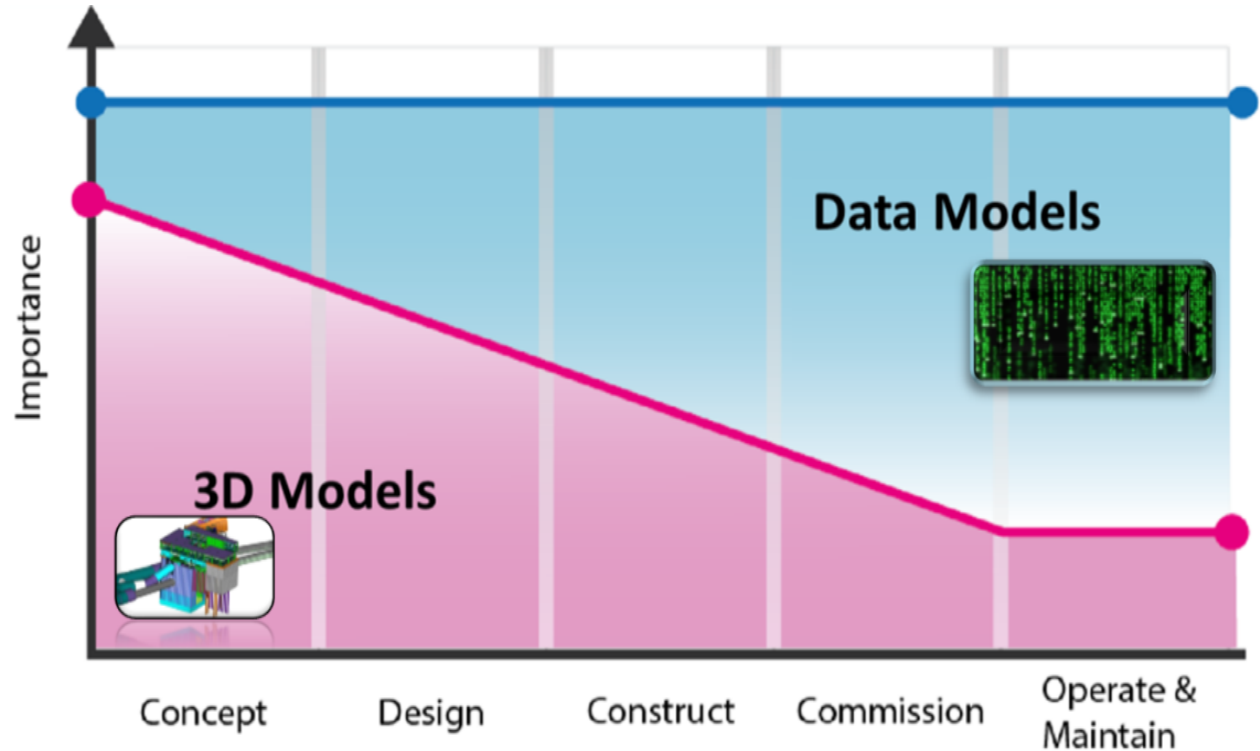
- Fully described
- Life cycle



# Graphical / Non-Graphical Models



- Information
- Data environment
- Data integrity
- Collaboration
- Technology
- Asset life-cycle
- New processes
- New project culture



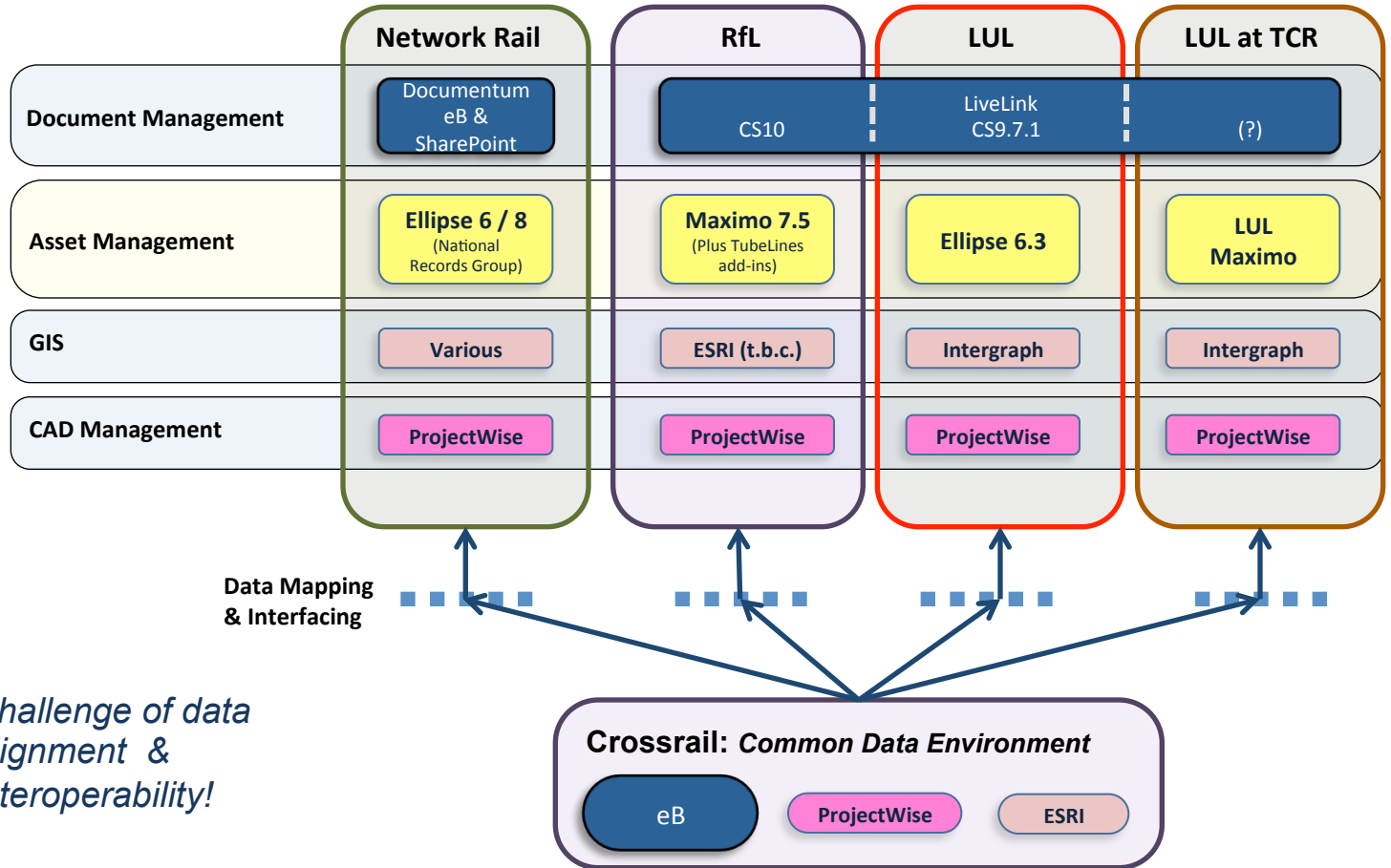


# “The End in Mind”

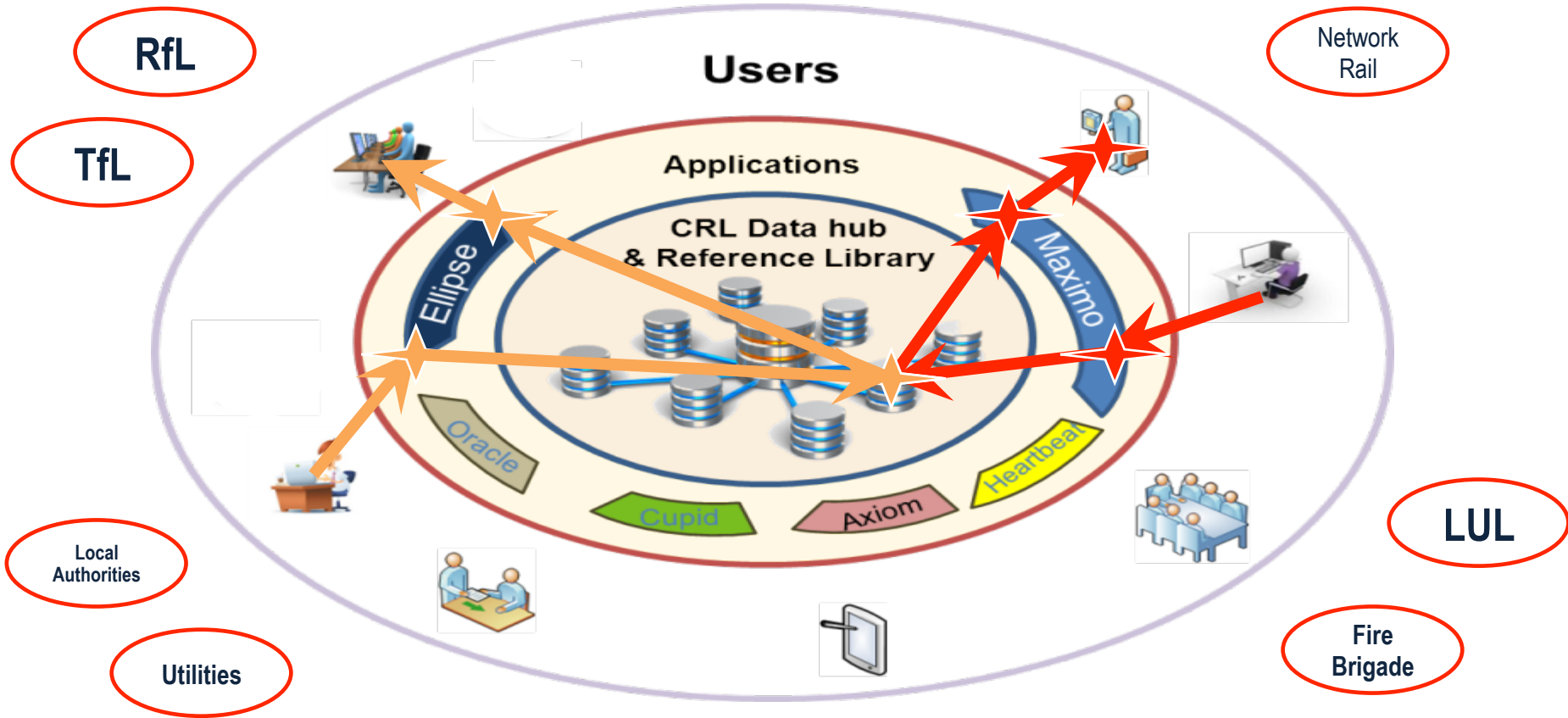


Starting with the end in mind.....

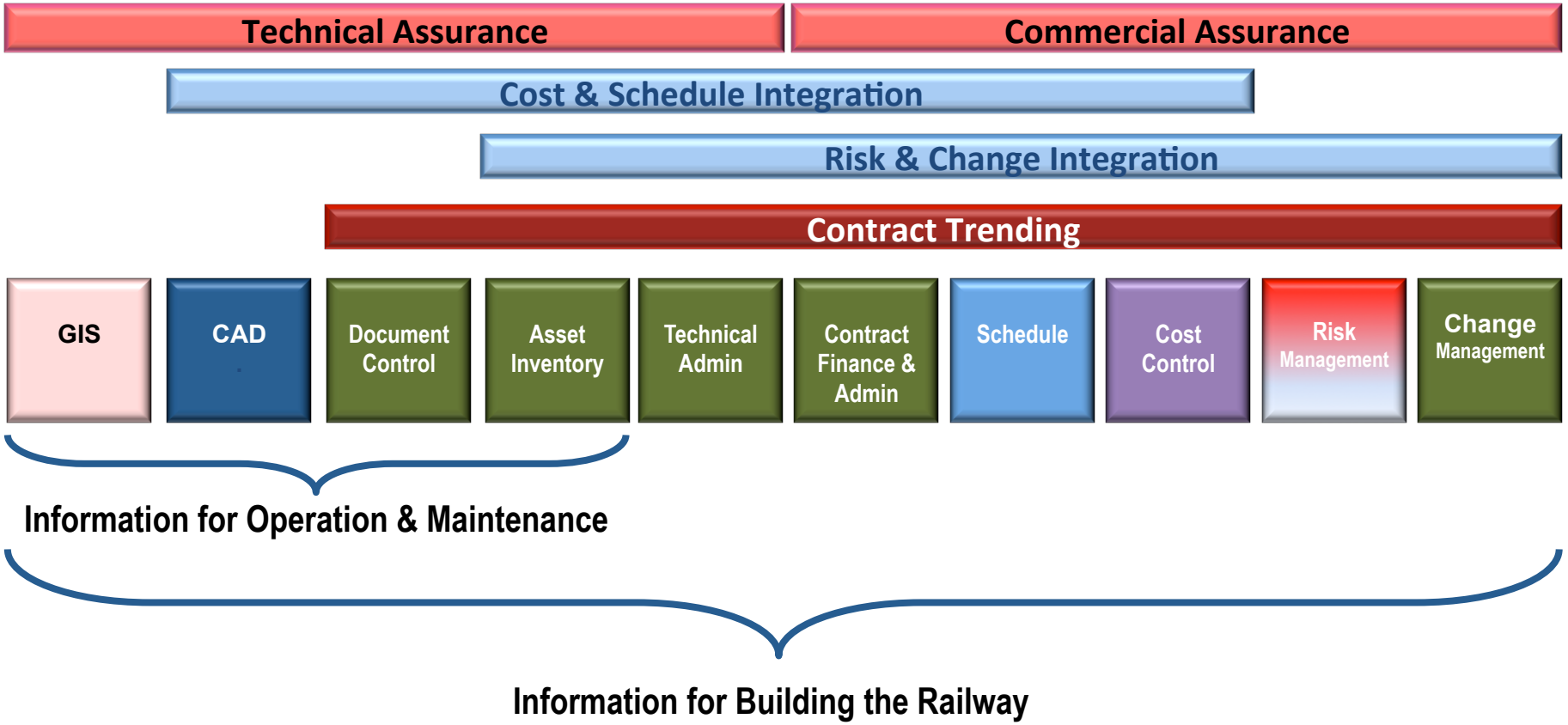
Our problem in Crossrail ..... →



# Data Centric in Operations & Maintenance



# Information Applications



# Information Applications



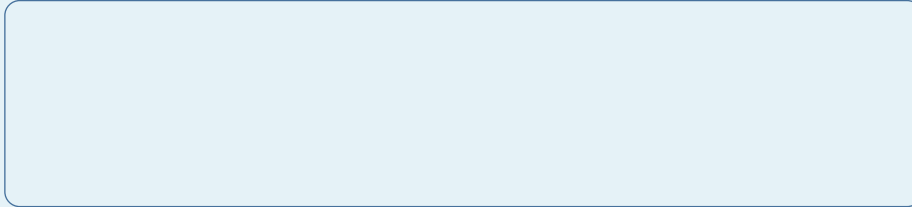
## Reporting via Data Warehouse

### Stand-alone applications

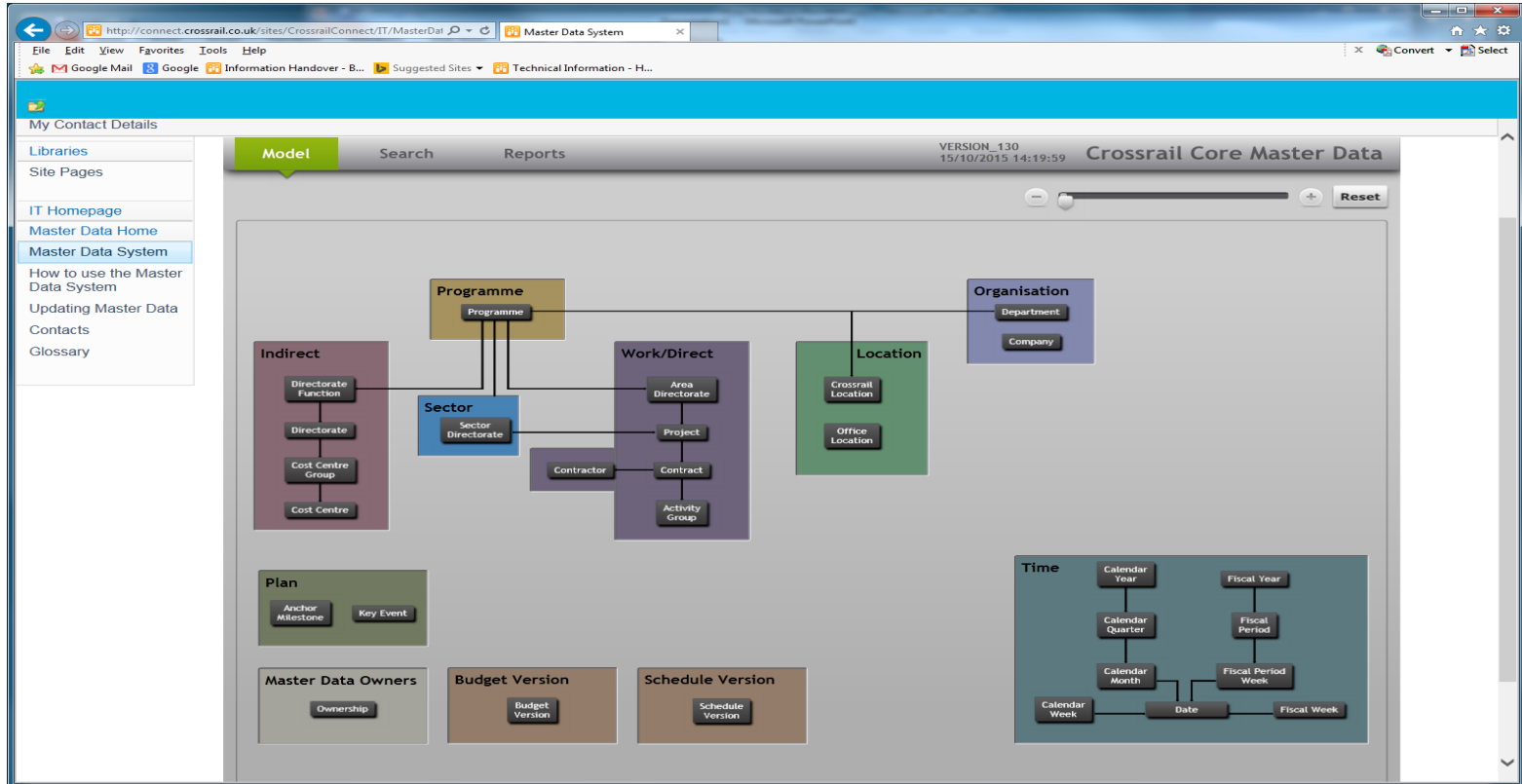


### Linked Databases

Main Information Database



# Master Data Management



Navigator  
 Resource Statuses

- Interruption Set
  - installed damaged
  - installed in wrong position
- Installed
- Not installed
- Setting out
- Installed in place
- Cables Run
  - Earthed
  - Inspected by CRL

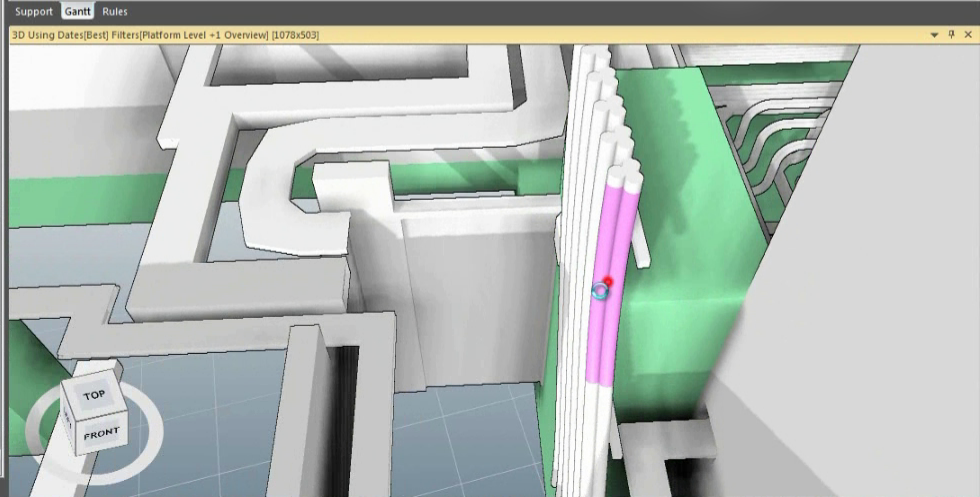
Colour

ID	Name	Duration	Start	Finish	F
396	ST1... Smart Sold [23499]	25m	09:50 19/10/15	10:15 19/10/15	
397	ST1... Smart Sold [23246]	25m	10:15 19/10/15	10:40 19/10/15	
398	ST1... Smart Sold [23645]	25m	10:40 19/10/15	11:05 19/10/15	
399	ST1... Smart Sold [23604]	25m	11:05 19/10/15	11:30 19/10/15	
400	ST1... Smart Sold [23668]	25m	11:30 19/10/15	11:55 19/10/15	
401	ST1... Smart Sold [23330]	25m	11:55 19/10/15	12:20 19/10/15	
402	ST1... Smart Sold [23624]	25m	12:20 19/10/15	12:45 19/10/15	
403	ST1... Smart Sold [23478]	25m	12:45 19/10/15	13:10 19/10/15	
404	ST1... Smart Sold [23372]	25m	13:10 19/10/15	13:35 19/10/15	
405	ST1... Smart Sold [23688]	25m	13:35 19/10/15	14:00 19/10/15	
406	ST1... Smart Sold [23100]	25m	14:00 19/10/15	14:25 19/10/15	
407	ST1... Smart Sold [23100]	25m	14:25 19/10/15	14:50 19/10/15	
408	ST1... Smart Sold [23100]	25m	14:50 19/10/15	15:15 19/10/15	
409	ST1... Smart Sold [23100]	25m	15:15 19/10/15	15:40 19/10/15	
410	ST1... Smart Sold [23100]	25m	15:40 19/10/15	16:05 19/10/15	
411	ST1... Smart Sold [23100]	25m	16:05 19/10/15	16:30 19/10/15	
412	ST1... Smart Sold [23100]	25m	16:30 19/10/15	16:55 19/10/15	

Support Gantt Rules  
 3D Using Dates(Best) Filters(Platform Level +1 Overview) [1078x503]

# BIM in Planning

- External Data
- Resource Appearance Profiles
- Filters
- 3D Sets
- 3D Paths
- Cutting Planes
- Viewpoints
- Animations
- Spatial Coordination
- 3D Grids
- Project
- Baselines and Scenarios
- User Fields
- Alerts
- Calendars
- Activity Codes
- Risks
- Companies



# BIM in Planning



## CONNECT ONLINE ▶

Primavera Planning Tool  
 Primavera Site Directions

Welcome to the Crossrail Planning Page

Daily Progress

**Jan 08** TBM 39,492m SCL Engagement Material

**Forward Looking Metrics**  
 Tunnel Construction | Systemwide Handover Dates

**Reference**  
 Planning Manual  
 Another Milestone Change Control  
 Open System Wide Dashboard  
 Industry Partner Dashboard  
 Stage Diagrams  
 Scope Book  
 Planning Workshops

**Interface**  
 Draftsions | **PHASING** | Tracker

**Knowledge Centre**  
 West Area Curves  
 Procurement Schedule  
 Lifts & Escalators

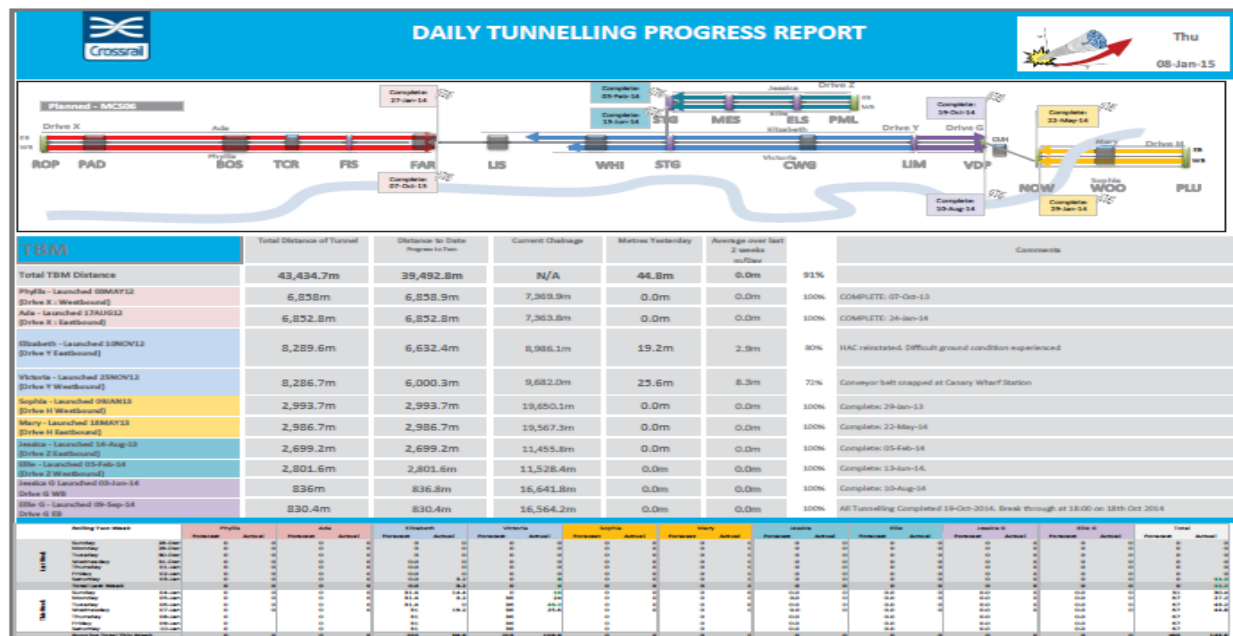
**One Page**

**Stations Steering Group Dashboards**

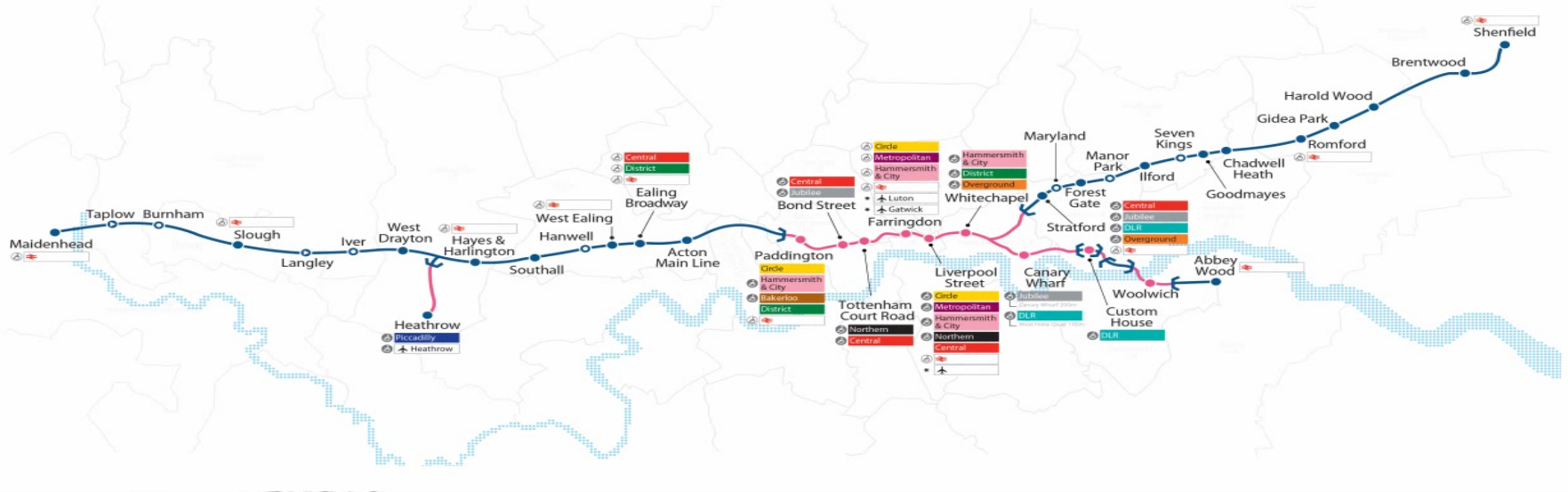
West Surface Works to Maidenhead and Heathrow

Click an area on the diagram or on the Crossrail route map for a planning report. Items in grey text indicate no report is currently available for that area/topic.

Contact Nish Patel (x3664), Rob Linta



# BIM in Action - Planning







# BIM in Design

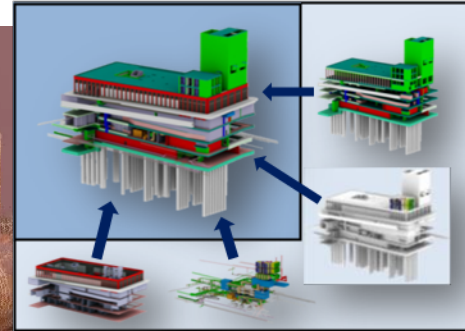
# BIM in Action - Design



- Greater Visibility of Design
- Improved Collective Understanding
- Managed Design & Clash Detection
- Early Conflict Mitigation
- Automated CAD Quality Assurance
- Managing Processes
- Collaborative model use e.g. SMART Boards

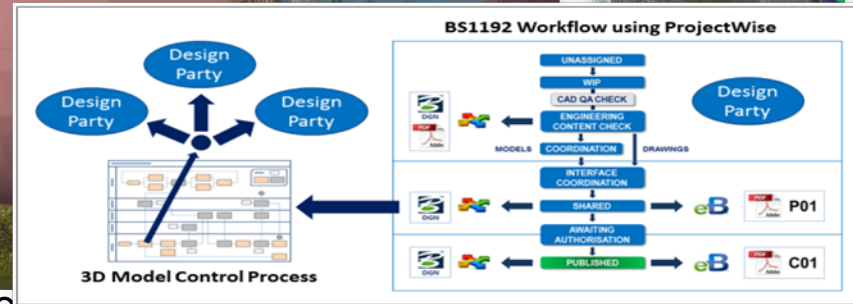
## Gate Reviews for design

Implementing 3D Model-based design reviews using SMART boards and involving all parties involved in the design process



## Control Processes

Introduced a “3D Model Control” process to support and manage 3D models between multiple design parties



federated information models.

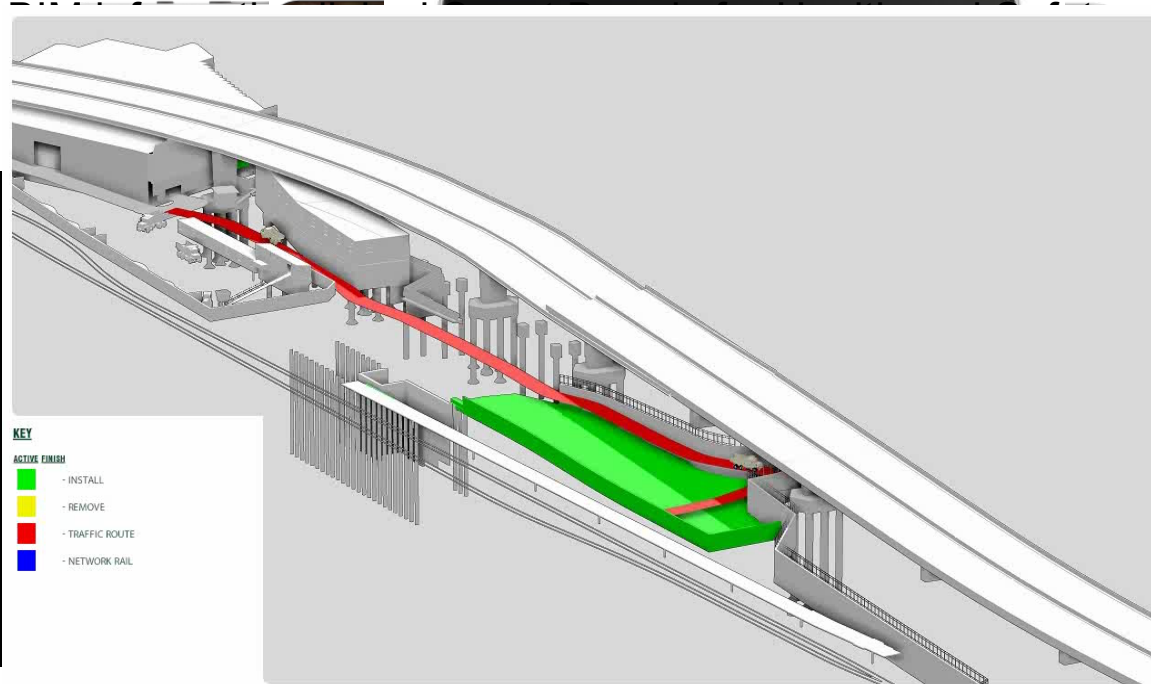
# BIM in Construction

An aerial photograph of a large-scale construction project. In the foreground, a complex network of steel beams and scaffolding is visible, indicating the early stages of a new structure or a major renovation. A tall, white lattice crane stands prominently in the middle ground. To the right, a large, multi-story building with a classical facade, featuring arched windows and decorative elements, is partially obscured by construction materials and equipment. The ground is a mix of dirt, concrete, and various construction supplies. The overall scene depicts a busy and intricate construction environment.

# BIM in Action - Construction



- Improved Understanding
- Demonstrating Readiness to Dig
- Health and Safety
- Improved Interface Management
- Augmented Reality
- Virtual Reality
- On-Site Document Verification
- Field Supervisor - EDMS in the field
- Mobile GIS
- 4D Modelling / Scheduling
- Contract Performance Analysis



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- Access up-to-date information
- Swifter response times
- GIS + models + documentation
- Common understanding



MOVING LONDON FORWARD

Orbit  Walk

M&E

Assets

People

Xray mode

MAPS

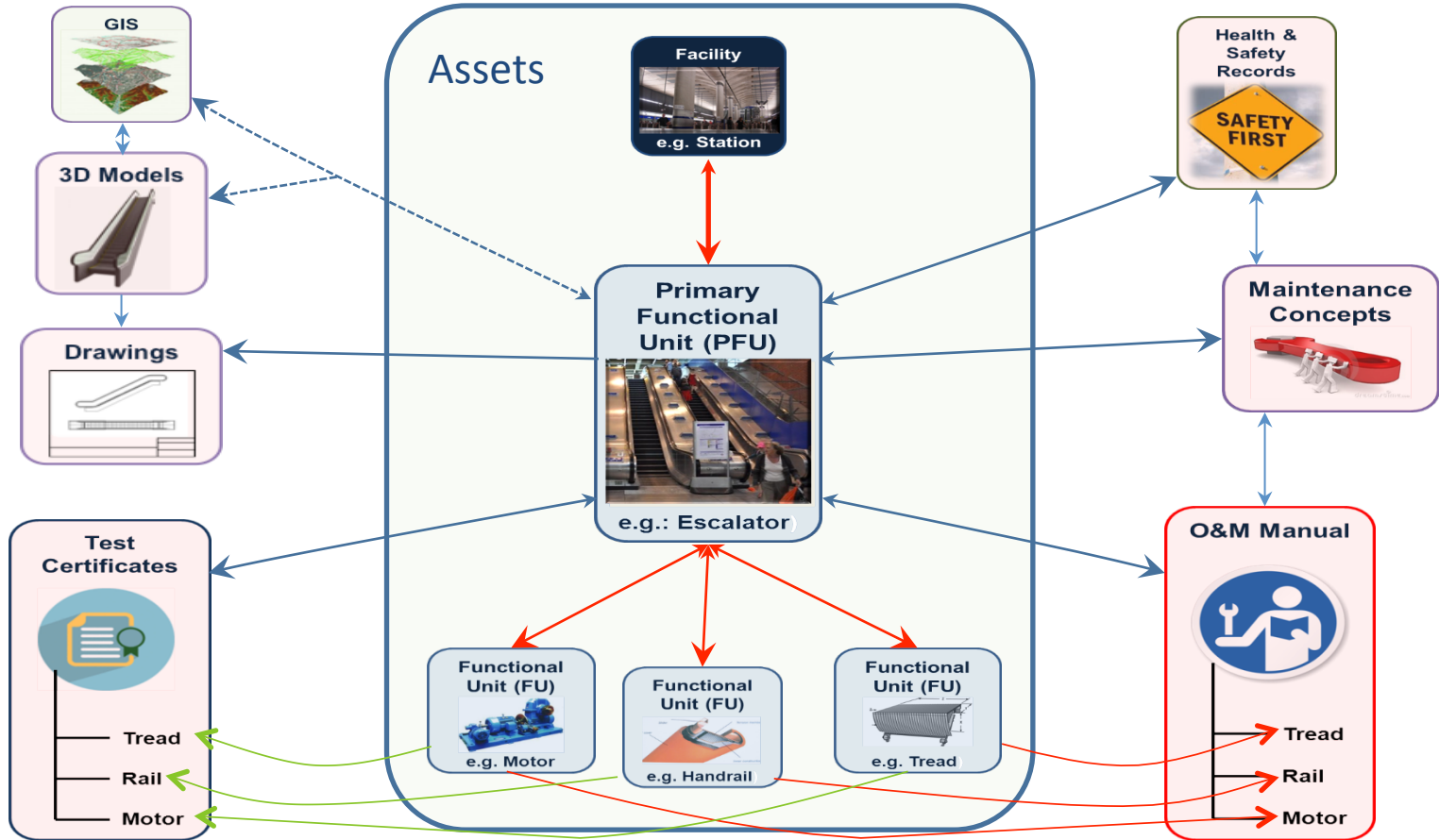
STATIONS

UNDERGROUND



# BIM in Operations & Maintenance

# Structured Information

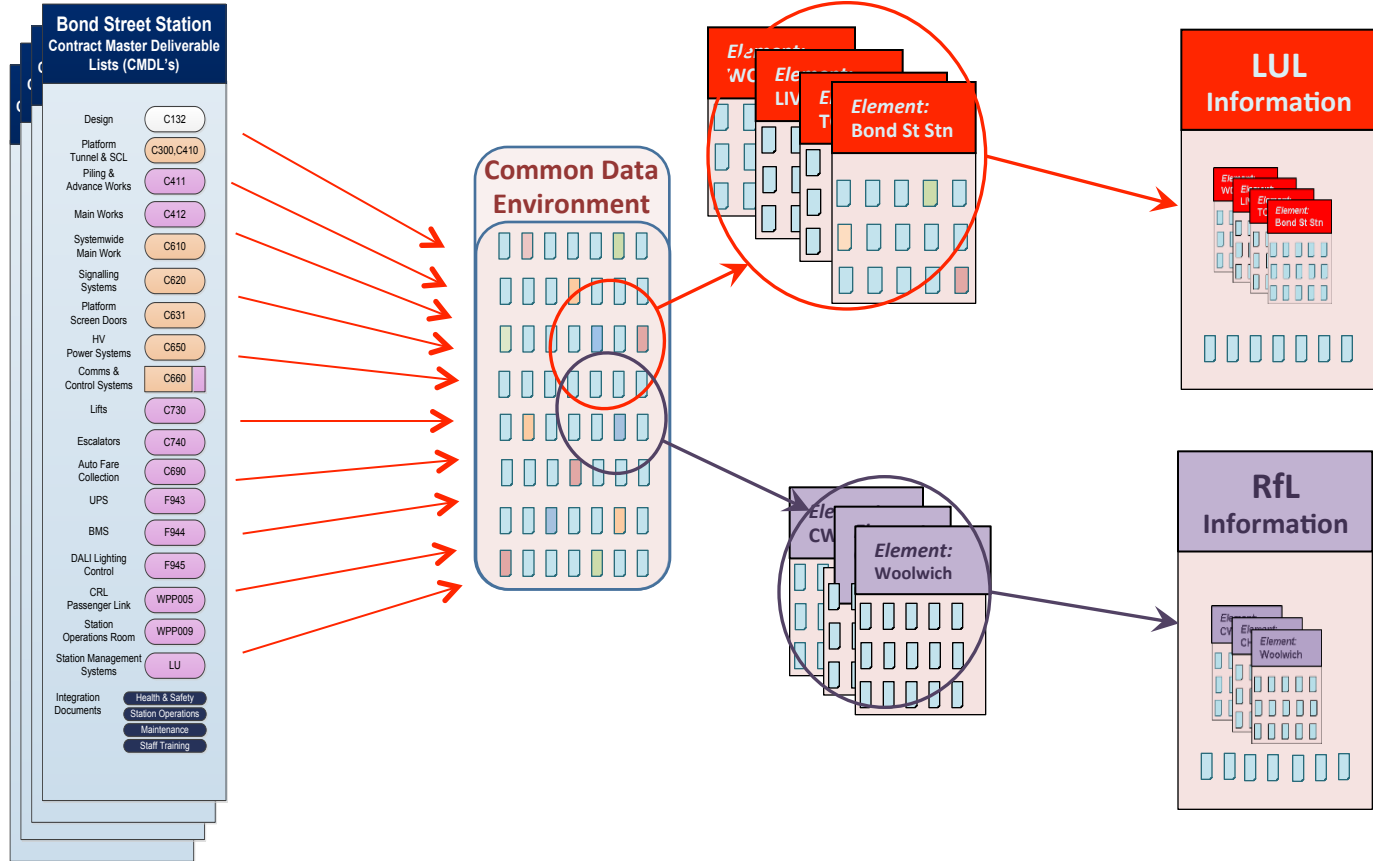


# Information Handover Principles



Contract Templates for each facility

Element Handover "Playlists"



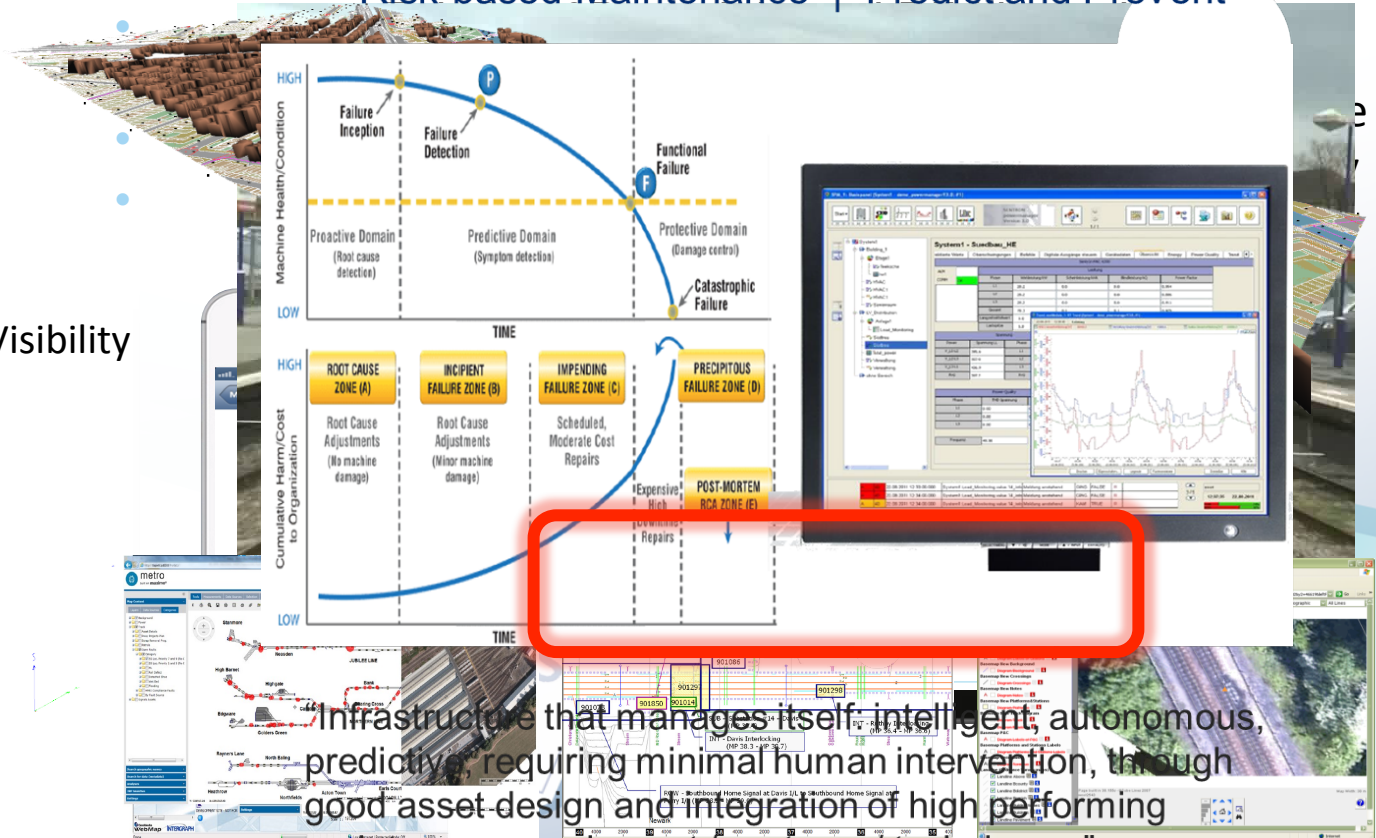
How we are handing over the CDE from Capex into Opex..

# BIM in Action – Operations and Maintenance



## Risk-based Maintenance | Predict and Prevent

- Maintenance Concepts
- Augmented Reality
- Virtual Reality
- GIS linked to Maximo
- Digital Processes Drive Visibility
- Digital triage of Faults
- Virtual Maintenance
- CDE underpinning O&M





# Return on Investment



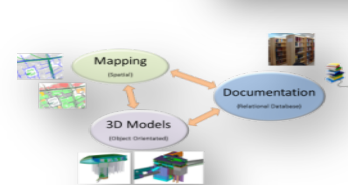
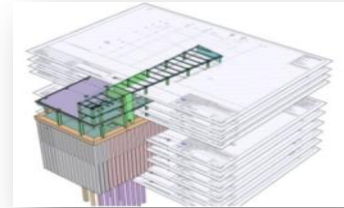
- **The direct benefits we have delivered include:**
  - Reduced wastage (minimising clashes)
  - Improved efficiencies (faster collaborative approvals)
  - Reduced information loss (using only the most recent document/drawings)
  - Improved safety (model visualisations leading to better awareness)
  - Reduced programme risk (through 4D analysis)
  - Improved performance (linking models into GIS mapping)
  - Collaborative model transfer from designer to contractor
  - Innovative asset management (linking models directly to our asset database)

# Non-Financial Benefits



These include:

- ◆ Safety  
Better understanding of construction through visualisations, by combining 2D and 3D
- ◆ Efficiency  
Reduction in waste through model clash detection
- ◆ Effectiveness  
Always the most up-to-date information from an integrated single source of truth



# Cost and Time Savings



- CAD User Management Tools
- Customised CAD Workflow to BS1192
- CAD QA Customisation
- Smart Design
- Risk Reduction with 4D
- Risk Reduction – Concreting Train
- GIS
- Common Data Environment Efficiencies

**Cost of CRL Records Store**

Licensing, hosting etc: £0.6m  
 One-off cost of creating workflows etc. in 2010/11 = £3m

**Project software Costs saved per annum:**

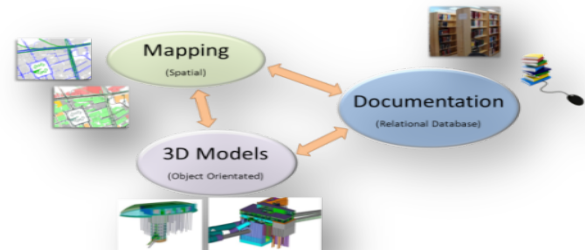
Document Control	£1.5m
NEC Contract administration	£1.5m
Project Technical Requests	£1m
Asset Inventory Management	£1m
Snagging	£0.5m
<b>Total p.a. = &gt;&gt; £5m</b>	

*Note: Indirect benefits give £3m*

# Lessons Learned... the hard way!



- Key principles:
  - Treat data as a valuable resource! (owned by the Client)
  - Establish your requirements (at business and project level)
  - Structure data with the end-use in mind
  - Good asset breakdown structure & classification
  - Use relational databases
  - Become data-centric (the CDE)
- Beware (or mindful of):
  - Data interoperability (be prescriptive!)
  - Being led by IT!
  - People don't like change!



# Crossrail in Numbers

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£14,800,000	Cost
2,054,100	e-Documents stored – so far!
1,000,000	Assets to be Tagged
301,147	Drawings – so far!
8,250	Individual Document users – so far!
650	CAD users – so far!
25	Main Construction contracts
8	Main Design contracts
2	Future Infrastructure maintainers
<b>1</b>	<b>Crossrail</b>

***It would all be much harder without BIM!***



**Thank You!**