Crossrail: A Case Study in BIM

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Agenda

- Briefly set the scene…
- What BIM in Crossrail currently looks like
- Summary
Crossrail: Route Across London
Benefits

- £42bn boost to economy
- Connect Heathrow with the West End, the City and Canary Wharf
- Support London as a leading world city
- Generate thousands of jobs
Decreasing journey times

<table>
<thead>
<tr>
<th>Route</th>
<th>Current journey time</th>
<th>Crossrail journey time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slough to Tottenham Court Road</td>
<td>55 minutes</td>
<td>36 minutes</td>
</tr>
<tr>
<td>Ilford to Bond Street</td>
<td>35 minutes</td>
<td>22 minutes</td>
</tr>
<tr>
<td>Heathrow to Liverpool Street</td>
<td>55 minutes</td>
<td>36 minutes</td>
</tr>
<tr>
<td>Liverpool Street to Abbey Wood</td>
<td>40 minutes</td>
<td>22 minutes</td>
</tr>
<tr>
<td>Paddington to Canary Wharf</td>
<td>30 minutes</td>
<td>17 minutes</td>
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</table>
Crossrail Funding - £14.8bn

Crossrail

Sponsors Funding Account

£7.15bn

TfL Funding

Developers Contribution (£300m)

Community Infrastructure Levy (£300m)

GLA (BRS Borrowing and direct contribution: £4.1bn)

TFL Core Contribution (£1.9bn)

Sale of Surplus Land and Property (£545m)

£2.45bn

DfT Funding

BAA Plc (£230m)

CoL (£250m)

DfT Grant (£4.7bn)

£5.2bn

Other funding

Network Rail ONWs (£2.3bn)

Other income including CoL Voluntary Contributions (£250m)

Other residual costs (£-100m)
Programme


- Bill
- Funding
- Land & Property Acquisition
- Engineering Design
- Tunnels & Station Procurement
- Enabling Works
- Central Section Works Tunnelling & Stations
- Rolling Stock and Depot – Spec, Procure, Build (CRL)
- Systems Installation
- Testing / Commissioning
- Trial Operations / Staged Opening
Contractual Complexity
Crossrail and BIM...
Virtual Crossrail

Building Information Modelling:

Creating the “virtual” Crossrail
A reminder of the old world........
Project Delivery with BIM

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.
CRL BIM Strategy

Reflects

- The BIM lifecycle status
- We’ve been working in a BIM environment for years

Comprises 3 elements

<table>
<thead>
<tr>
<th>Technology Development</th>
<th>Adoption of Data into IM Systems</th>
<th>Leading BIM in Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Partnership with Bentley</td>
<td>Vision for TfL asset management</td>
<td>Maximising use of data and technology</td>
</tr>
<tr>
<td>Information Academy</td>
<td>Harmonisation of LUL/RFL/NR asset classification systems</td>
<td>Visualisation “Toolbox”</td>
</tr>
<tr>
<td>Industry Expert Panel</td>
<td>Migration strategy</td>
<td>4D analyses to mitigate interface risks</td>
</tr>
</tbody>
</table>
“To ensure that information quality and integrity is not compromised as it is passed between organisations and applications during the delivery of the infrastructure asset”
Enterprise Information

Employers Requirements

Enterprise Information

Technical Information ("BIM" focus)

Asset & Handover Information to IM’s

Concept Design
Preliminary Design
Detailed Design
Construction
Testing
Commissioning
Master Data Management

(Keep it simple!)
Specifications and Standards

- Developed discipline-based 3D Model level-of-development Specifications and Standards – using BS1192
  - Defines how to collaborate
  - Defines appropriate levels of detail
  - Ensures consistency
Managing Processes

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

- **Control Process**
  - Introduced a “3D Model Control” process to support and manage 3D models between multiple design parties
Validating 3D Designs

- **Laser Scanning**
  - Comparing 3D design models to laser scanned data to check and validate the information

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3D Design Model  Laser Scan
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)
Cost Savings

- Finding information – from our “single source of truth”
- The creation of non-CAD deliverables e.g. reports, lists, mailings, databases
- The creation of models and drawings

At Farringdon Station
- 3D model linked to the delivery programme
- cost £120k but saved over £8million from risk contingency (interfacing complexity)
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
BIM in Action…

- Mapping (Spatial)
- 3D Models (Object Orientated)
- Documentation (Relational Database)
3D Information Models

Tottenham Court Road Station
BIM Making things happen.....
Station construction is well underway

- Bond Street East Ticket Hall
- TCR West Ticket Hall
- Canary Wharf
Tunnelling
Augmented Reality
Whole Life Management

Capturing Asset Information

- Mapping (Spatial)
- 3D Models (Object Oriented)
- Documentation (Relational Database)
Defines the types of assets of interest to Crossrail

Asset Data Dictionary Definition Documents (AD4’s) define:
- Functions and the Classes that relate to them
- Classes and the Attributes relevant to them
- What an Attribute means e.g. Length
Using “As-constructed” data
Asset Management

Integrated Digital Asset Management System

- Asset information
- Condition & Performance data
- Inventory Management
- Cost & Scheduling
- Purchasing & Commercial
- Vendor Management
- Works Management

Third Party Asset Management Systems

Crossrail Asset Datastore

Data Sources

Migration to Datastore
Crossrail BIM Vision

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
Interactive Data
And to Conclude……
Conclusion

Seen what BIM currently looks like

- Creating a virtual world as well as a physical one
- Embracing new technology
- Demonstrating efficiencies
Conclusion

Capturing Asset Information
It would all be much harder without BIM!

<table>
<thead>
<tr>
<th>£14,800,000,000</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>1,275,000</td>
<td>CAD Model files – so far!</td>
</tr>
<tr>
<td>830,000</td>
<td>e-Documents stored – so far!</td>
</tr>
<tr>
<td>650,000</td>
<td>Assets to be tagged</td>
</tr>
<tr>
<td>8,250</td>
<td>Individual Document users – so far!</td>
</tr>
<tr>
<td>650</td>
<td>Individual CAD users – so far!</td>
</tr>
<tr>
<td>61</td>
<td>Main Construction Contracts</td>
</tr>
<tr>
<td>25</td>
<td>Main Design Contracts</td>
</tr>
<tr>
<td>8</td>
<td>Main Central Interchanges</td>
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<tr>
<td>2</td>
<td>Future Infrastructure Maintainers</td>
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<tr>
<td>1</td>
<td>Crossrail</td>
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</table>
Thank you!