Crossrail: Design, Construction & Operations with Geospatial Data

Malcolm Taylor
Crossrail Head of Technical Information
January 2018
Introduction

Common Data Environment (re-engineering delivery)

Spatial data in:
- Design
- Construction
- Operational asset management

Benefits and Lessons Learned

Key message:
The importance of BIM and spatial data in creating infrastructure
Introduction
Crossrail – enabling London to grow

- £14.8bn cost
- £42bn net benefit
- 118 km length
- 40 (10 new) stations
- 24 Trains/hour
- 200m journeys pa
Challenges: Contractual

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

- They all use information
- Need information to collaborate (!)
Challenges: Construction & Environmental
Challenges: Spatial Accuracy

![Diagram showing spatial accuracy challenges with 50cm deviation](image-url)
The physical scale of the Crossrail project is replicated by the scale of the Virtual project.
Building Two Railways

Physical

Digital
The importance of Models (and BIM)

- Information and data…
- Maps and models…
- Making decisions…
  - better
  - quicker
Common Data Environment

- Re-defining Project Information Management
- Re-engineering delivery
Structured Data and the CDE

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
  – Exploiting technologies e.g. databases

• New defined roles and procedures
  – To BS1192
  – Deliverables and processes set out
Our Common Data Environment

Careful – don’t be application-centric!
Our Common Data Environment

Reporting via Data Warehouse

Stand-alone applications

- GIS
- CAD
- Document Control
- Asset Inventory
- Technical Admin

Direct Reporting

- Admin
- Cost Control
- Risk Management
- Change Management

3 Linked Databases

Main Information Database

- Single source of data
- CRL owned systems
- Contractual
- Must be used by everyone!

Our Common Data Environment
Our CDE workflows

GIS workflows:
- London Survey Grid
- Estates management
- Automated claims reporting
- Integration with CAD

Data & Documents (Relational)

3D – 5D Models (Object-orientated)

CAD workflows:
- CAD user tools
- CAD QC/QA
- User Management Tools
- Customised BS1192 Workflow

GIS Mapping (Spatial)

Documentation workflows:
- NEC3Contract Management (£8.3bn)
- Asset Inventory Structure (ABS)
- Crossrail Management System (CMS)
- Document Management System
- Assurance reporting
- Materials compliance system
- Project Technical Requests
- Observation reporting
- Snagging
- Automatic pdf drawings from ProjectWise
- Contract deliverables

90% of data in 3 linked databases
Benefits of the CDE

Benefits…..
• Single source of truth
• Avoids duplication
• Encourages collaboration
• Reduces time and cost in producing coordinated data
• Controls change effectively
• Consistent reliable data
• Reduced waste

Cost of the documentation/information database:
Licensing, hosting etc: £0.7m p.a.
One-off cost of creating workflows etc. in 2010/12 = £3m

Typical project software costs saved per annum:
- Document Control £1.5m
- NEC Contract administration £2m
- Project Technical Requests £1m
- Asset Inventory Management £1m
- Assurance £1m
- Snagging £0.5m
- Others £1.5m

Cash benefit >>£8m per year for 6 years
(Plus related data, business agility, less IT support etc.)
Spatial data in:

- Design
- Construction
- Operational asset management
Spatial Visualisation - Design

- Greater Visibility of Design
- Improved Collective Understanding
- Managed Design & Clash Detection
- Early Conflict Mitigation
- Automated CAD Quality Assurance
- Managing Processes

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

Delivering value to the client by creating collaborated, federated information models.
Spatial Visualisation - Construction

- Improved Understanding with 4D
- Demonstrating Readiness to Dig
- Health and Safety
- Improved Interface Management
- Augmented Reality
- Virtual Reality
- On-Site Document Verification
- EDMS in the field
- Mobile GIS
- 4D/5D Modelling / Scheduling

Benefits:
- Better coordination
- Better decision-making
- Swifter response times
- Common understanding

Emergency Planning:
- Coordinating emergency services
- Live feeds to mobile control centres
- Access up-to-date information
Installation Progress Reports

Benefits:

- **Efficiencies**
  - Time savings
  - Agreed records
  - Process improvements

- **Effectiveness**
  - Quality record data
  - Good Assurance data
  - Maintenance benefits
Operations & Maintenance
BIM Metrics

Technical Information Dashboard

**Information Applications**
Design Performance Assurance Framework Averages

**GIS**
Maps Usage by Period

**CAD**
CAD Data Statistics by Period

**Document and Data Control**
Crossrail/Contractor Success

**Compliance Review Actions**

**Asset Information**
Assets Tagged and Named against target

**Assets Tags at T1 – Current positive for all contracts**

Contractor performance (24 contracts)
Contracts scoring over 97%
C298 C316 C340
C360 C501 C510

Total no. of documents (records) in eB
1,545,227

Model files in ProjectWise
180,673
+0.00% Period 11

Drawings in ProjectWise
243,545
+0.00% Period 11
Benefits & Lessons Learned
Lessons Learned

– 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

At the start:

• Good work breakdown structure
• Good asset breakdown structure & classification
• Use relational databases
• Become data-centric (the CDE)
• Information metrics

http://learninglegacy.crossrail.co.uk/
## Crossrail in Numbers

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>£14,800,000</td>
</tr>
<tr>
<td><strong>e-Documents stored</strong> - so far!</td>
<td>2,854,100</td>
</tr>
<tr>
<td><strong>Assets to be Tagged</strong></td>
<td>1,000,000</td>
</tr>
<tr>
<td><strong>Model files - so far!</strong></td>
<td>301,147</td>
</tr>
<tr>
<td><strong>Individual Information users - so far!</strong></td>
<td>8,250</td>
</tr>
<tr>
<td><strong>GIS mapping layers - so far!</strong></td>
<td>700</td>
</tr>
<tr>
<td><strong>Main Construction contracts</strong></td>
<td>114</td>
</tr>
<tr>
<td><strong>Main Design contracts</strong></td>
<td>23</td>
</tr>
<tr>
<td><strong>Future Infrastructure maintainers</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Crossrail</strong></td>
<td>1</td>
</tr>
</tbody>
</table>

*It would all be much harder without GIS & BIM!*
Thank you!