Lessons Learned Overview & BIM Delivery for Smart Asset Management

London Bridge Station Redevelopment – Thameslink Programme

Chris Lambe
Agenda

• **London Bridge Station Redevelopment** – Overview, Awards / Challenges / Innovations over the Programme

• **Continuous Improvement** – What does this look like

• **Building Information Modelling** – The Benefits, a Tool for Handback

• **Programme Monitoring/Reporting** – Implementation of Visual Analytics to drive towards Handback

• **Implementing Lessons Learned** – What can we do differently to mitigate against the challenges we experienced during LBSR
London Bridge Station Redevelopment - Overview

• 6 Year Programme split over 11 Entry Into Service (EIS) stages with each stage providing new operational assets and removal of existing assets

Key Challenges Faced
• Construction site interfacing with the operational station – public interface and operational railway
• This meant during the life span of this project we had 11 different stations each with its own set of challenges to maintain the construction programme without impacting on the station operations
• Every EIS date achieved on the LBSR programme
• Construction sequence improvements during life span, first bridge deck took 6 months to complete, the last of the 15 bridge decks took 4 weeks, demonstrating lessons learned through innovative techniques
• Stage sequencing of fixed milestones closely sequenced together did not allow the time / resource to complete in full before commencing on the next stage resulting in incomplete works building over the programme duration
• What can we do to mitigate this in the future?
15th May – Street level – Construction interface

Notes:
- All systems commissioned.
- Outstanding works carried out under blue topper / permit.
- Sign out swipe cards for outstanding works within areas shown.

Outstanding/ongoing works:
1. HE: Glazing/finishes, Bostwick gates, wayfinding, gate lines, metalwork and skirting
2. GE: Wayfinding, granite, SSS, metalwork and skirting and SU40 BREEC
3. FE: Stair S13 and escalator E20 testing and finishes, E19 and S12 finishes, granite, metalwork and skirting, SU43 MEP, wayfinding
4. CES corridor: High level services
5. SAB: PLG glazing, retail glazing, dry lining and MPE
6. Snagging in corridor and maybe access steps to TERS
7. Service yard roller shutters (to street and corridors)
8. Paving and kerbing
9. Terminating level: Terminating platform infill gates, monorail and balustrades as well as structural glazing to P15.
10. BOH corridors: Potential snagging will remain
Innovative Construction Techniques – Rebar design & Formwork for Quadripartite Arches
Continuous Improvement & Raising the Benchmark

• Throughout the course of the LBSR programme the Project have continually improved the standard of finishes and the associated assurance for each stage, learning each time from the previous & implementing the required mitigations

• Over the 11 Stages we continually sought ways of de-risking the programme by driving completion of areas in line with progressive assurance

• This was essential when delivering large areas and allowed completed works to be protected before going into operational use

• Our most recent EIS saw the benchmark raise again with the opening of Stainer Street with the BIM model, asset register and digital tagging all complete prior to EIS
Completing areas and opening them for operational use before programmed date for beneficial use of the station
Traditional use of BIM

• BIM Level 1
• On implementation of LBSR the Project was not required to provide an As-Built 3D model
• The Project constructed over 11 Stages, the first 2 of these did not capture any deviations from the design via Site Technical Queries
• This has resulted in approximately 85% accurate As-Built 3D model today
• 3D design used to reduce the amount services clashes and co-ordinate openings
• 3D design model of the structure used by the Architectural teams to visualise finishing details
Why has LBSR utilised BIM? – Smart Asset Management

• Why did LBSR implement BIM without a 3D As-Built model?
• One of the benefits of using the BIM features associated with Level 2 is the ability of smart asset registers
• The accumulation of 6 years of work has amassed;
  – 14000 plus Red Line mark ups
  – 8000 plus As-Builts
  – 8000 plus maintainable assets
  – 6000 plus non maintainable fabric assets
  – 2000 plus assurance files
  – 150 Operation & Maintenance Manuals
• Traditional storage system for the above works is the National Records Group incorporated into a Health & Safety File, the title from the requestor must be exact to retrieve the information which may take up to 4 weeks to return
Why has LBSR utilised BIM? – Smart Asset Management
The vast amounts of asset information, related assurance & maintenance called for an alternative system to allow the Station & NR Asset Maintainers a tool to navigate through to pin point the required documentation.

The introduction of BIM to utilise features such as smart asset database provided the platform to achieve this.

Scanned 3D models of the station areas with maintainable assts tagged with physical BIM ID and digitally tagged on the Smart Asset Register to associate key assurance information such as O&M, Red- Line/As-Built and the ability to provide Planned Preventative Maintenance information/ Reactive fault data to each asset at a click of a button.

This provided the NR Asset owner with the confidence that the information to maintain the station was accessible and de-risked the handback process.
Stainer Street – Screenshot of BIM Platform
BIM – Platform hosted on Salesforce contains the associated assurance and maintenance information

<table>
<thead>
<tr>
<th>Details</th>
<th>Asset Location</th>
<th>Media</th>
<th>PPM</th>
<th>Reactive</th>
<th>Cond. Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset 101</td>
<td>NPIB/MIP/00329</td>
<td>Traffic Light</td>
<td>PPM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model No.</td>
<td>5201055</td>
<td>110V Socket Outlet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Asset Details**
- Asset Sub-Type: Electrical
- Location: Metro Rail
- 110V Socket Outlet
- Asset System: Small Power

**PPM Information**
- PPM Class: None
- PPM Rating: None
- PPM Location: None
- PPM feathers: None
- PPM Comment: None
- Part of Failed Inspection: None

**Related O&M (linked)**
- Hosted O&M Manual
- O&M Manual
- PPM Information

**PPM Info**
- Asset Status:
  - Operational
  - Normal Service Like Normal
  - 28
Stainer Street – Video of BIM Platform
The Platform Containing the Building Information Model

The Platform
• Security
  – The cloud platform complies to all UK & European security standards necessary to Network Rail
• Automation
  – Defined systems & processes automated to conform to Government BIM Standards and FSG20 (Definitive Standard for Building Maintenance)
• Capture Reality
  – Photos, videos, photogrammetry and LIDAR surveys are captured to create a digital model of the assets
• Unlimited
  – Storage of photos/videos and assurance records
• Accessible
  – Ability to access asset information from mobile devices, tablets and desk tops
• Communication
  – In-built social media platforms to efficiently communicate and monitor asset condition
• Ownership
  – All information will be owned by the client commissioning the system. Information is licenced and transferable
## Compliance with Standards

<table>
<thead>
<tr>
<th>Standard / Guide</th>
<th>Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS7000-4 2013</td>
<td>Collaborative working, The influence of new technologies, effect of construction procurement and roles and responsibilities.</td>
</tr>
<tr>
<td>BS1192:2007 (ISO 19650)</td>
<td>Electronic Data Management - This standard establishes the methodology for managing the production, distribution and quality of construction information, including that generated by CAD systems, using a disciplined process for collaboration and a specified naming policy.</td>
</tr>
<tr>
<td>PAS1192-2 (ISO 19650)</td>
<td>CAPEX information Management - PAS 1192-2; specifies requirements for achieving building information modelling (BIM) Level 2</td>
</tr>
<tr>
<td>PAS1192-3</td>
<td>OPEX information Management - focuses on the operational phase of assets irrespective of whether these were commissioned through direct capital works, acquired through transfer of ownership or already existed in an asset portfolio</td>
</tr>
<tr>
<td>BS1192-4</td>
<td>Information Exchange - defines the collaborative Production of Architectural, Engineering and Construction Information Part 4 – Client information requirements (COBie)</td>
</tr>
<tr>
<td>PAS1192-5</td>
<td>Information Security</td>
</tr>
<tr>
<td>BS8536-1:2015</td>
<td>Better Outcomes - BS 8536-1:2015; gives recommendations for briefing for design and construction, to ensure that designers consider the expected performance of a building in use. The standard applies to all new buildings projects and major refurbishments</td>
</tr>
<tr>
<td>BS8541 1-4</td>
<td>Information definition - Library objects for architecture, engineering and construction. And Defines properties and multiple levels of information</td>
</tr>
</tbody>
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Monitoring BIM Handback Data

• Through close collaboration with the Asset Owner (Client) we have established what fields need to be tracked and how successful completion is recorded

• Over the Project duration we have found visual analytical data from Microsoft PowerBi has helped focus the delivery teams efforts co-ordinate suppliers to close out areas of the station

• The following slides are fed from P6 programme information and completion programmes split into 17 reportable areas over 2 physical station levels

• Co-ordinating defect close out in conjunction with associated assurance such as O&M/ Red Line drawing mark ups and asset register by room drives the completion %

• We have separated out the deliverables required to allow the Project to achieve handback of Maintenance and the deliverables required to close out the Project
Room Readiness - Landing Page

Back of House East - South, Station Accommodation Block & Accommodation Blocks A, B & C

Platform Level - Service Spine, Terminus Level & Through Level

Main Concourse, BoH West-North & South, BoH East - North & Western Arcade. Including All Lifts Escalators and associated Lift Motor Rooms
Main Concourse, BoH West-North & South, BoH East - North & Western Arcade. Including All Lifts Escalators and associated Lift Motor Rooms

<table>
<thead>
<tr>
<th>BOH East-North</th>
<th>BOH West-North</th>
<th>BOH West-South</th>
<th>L&amp;E</th>
<th>Main Concourse</th>
<th>Western Arcade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ben Howard</td>
<td>Max Lloyd</td>
<td></td>
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28/10/2018

Count of Rooms: 232

<table>
<thead>
<tr>
<th></th>
<th>Cumulative Actual</th>
<th>Cumulative Planned</th>
<th>Week Look Ahead (02/11/18)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dec 23 %</td>
<td>Dec 24 %</td>
<td>Dec 25 %</td>
</tr>
<tr>
<td></td>
<td>Mar 27 %</td>
<td>Mar 28 %</td>
<td>Mar 29 %</td>
</tr>
</tbody>
</table>

51 DOWL <50
51 Q&M
54 Asset Reg
51 Red Line Drawings
24 Key Suited
27 OPAS Building Blocks
24 RAM Inspection
51 AMP issued to NR

51 As-Built Drawings
33 Room tagged
43 BIM Scanned
26 Digitally Tagged
51 Assurance Files Submitted
24 Engineering Validation
0 H&S File
83 Dowel Complete
0 OPAS Taxonomy
Continuous Improvement & Raising the Benchmark – Next Time?

- Building on the implementation of BIM – The Project have proved that EIS can have assurance and contained in the BIM Model
- Capturing the areas that are to be Entered Into Service onto the BIM model linking the Form 5 assurance information as evidence for opening
  - Form 5 to show the appropriate LUX levels achieved
  - Form 5 to show PAVA audio levels achieved
  - Form 5 to show floor slip resistance values achieved
  - Form 5 to show structural integrity process validated
  - Form 5 to show Fire system and interfaces such as extract are witnessed & commissioned
  - Form 5 to show CCTV is monitoring key operational assets/ station access/egress/ lifts/escalators/ gantlines/ platforms where applicable
  - Form 5 for public health systems
- Safeguards the project on evidence to open area for public use and mitigates scope creep through wear and tear issues as areas would have photogrammetry and LIDAR surveys as evidence at EIS
- Benefit for the client as it provides a visual closeout programme for the area and mitigates against the loss of staff turnover as scope would be defined