Case Study:
Implementing Quality Control Management at London Bridge station

Thameslink Programme

Recommendations for future projects to understand the importance of quality assurance and how to effectively control it during a major project.

Case study background

Whilst mega projects have been known to suffer from cost overrun and close monitoring of health and safety, poor regard is shown towards quality control management. From the commencement through to its completion, the team at London Bridge were extremely keen to avoid past mistakes and develop a strong culture of quality control management across all its stakeholders.

The aim and objectives of this industry case study is to demonstrate why quality control management was of vital importance and how the team looked to adopt a proactive methodology lead by senior management to ensure lessons learnt from the early stage of the project were adopted to create a ‘do it right first time’ culture.

The customer and end users of any project are solely focused on the Quality, durability and maintainability of the new station. Our quality vision as a project was for the delivery to be in line with legal requirements, and end user expectations with the quality of the works being right fist time whilst taking into consideration programme, cost and safety.
The construction industry has been historically criticized for its poor levels of quality control with regards to delivery and inefficient practices across various projects. When it comes to a mega project the risk of quality control systems is increased and without a strong team of surveillance officers/quality control management systems most projects will suffer from extensive corrective action and rework costs.

During the initial phase, London Bridge station, as with most construction projects had a minimal quality presence on site. The first phase of station concourse fit-out, including glass re-enforced concrete (GRC) and metal cladding began in 2015. Prior to the second phase starting in early 2016 the project’s senior management team took a major step in ensuring the lessons learnt from the first phase were fully incorporated into the 2016 Quality strategy. This strategy was to lay the foundations to the successful delivery and entry into service of the station in May 2018.

**Quality control management and continuous improvement at Costain**

The ethos of Costain’s business is based upon continuous improvement for satisfying its customer requirements today and tomorrow. Their corporate and local projects both implement continuous improvement programmes and strategies in the realm of quality planning.

The London Bridge Station Redevelopment (LBSR) team regularly liaised with the Group Technical Teams to continually strive to improve the quality planning aspect of the project and to provide technical advice with complex civils issues. The project also invested in a ‘Lean’ specialist, who successfully removed waste from the business process and ensured we had an adaptable, capable contract delivery process.

**LBSR – Quality control problems prior to 2016**

The LBSR project was a self-certified project. Self-certification relies heavily on trust between the client and the contractor. The client passed the responsibility for the standard of the works to Costain, which is probably where it should rest ultimately rather than re-examining works in detail at every point. This should reduce the amount of duplication of tests and inspections. At LBSR a collaborative relationship was formally set in place, allowing the client to inspect and approve the works progressively prior to full handover.

During the first phase of fit-out and finishing works, a number of quality issues were encountered resulting in a backlog of non-conformance reports (NCR), defects & outstanding works lists (DOWLs) and handover of completed assurance packages. Lessons learned workshops highlighted a number contributing factors, which included:

- Lack of quality resource
- Non-progressive assurance of site works leading to retrospective works inspections
- Damage to finished works (lack of protection)
- Poor trade-to-trade handover and interface planning
- Inadequate DOWL management and monitoring regime and a
- Lack of quality planning in relation to the scope of works.

The GRC and cladding works were highlighted for improvements during the detailed audit of the phase 1 works. Within the station concourse, as well as on the terminating course, one of the cladding materials used was GRC panels. These panels give a smooth, finished and functional look to the station. GRC panels are advantageous over standard concrete
panels; as they are generally more lightweight, have good blast properties, are crack resistant, environmentally friendly and are extremely durable and weather resistant.

In September 2015, the £8 million contract to design, supply and install around 5,600 square metres of GRC cladding throughout the station was awarded to a subcontractor. However, there were a number of workmanship issues that rendered the install unacceptable. Non-compliant fixings and install methodology of primary and secondary steel support structures were highlighted during the inspection of a few panels.

On further investigation it was established that all sampled GRC panel installs were defective, leading to the client requesting all panels and subsequent support structures be removed and reinstalled. The ITP check sheets were completed on paper but only provided limited evidence of progressive assurance and an audit trail. This forensic incident paved the way for the introduction of the 2016 Quality Strategy for the project.

**LBSR - Quality control solution**

Costain’s response to improving quality at London Bridge station was primarily guided by the project Quality Strategy and the group procedures and processes (Costain Way). It is this process that ensured and recorded quality compliance and managed any non-conforming products, resulting in a finished product that was demonstrably compliant.

During December 2015, the project’s senior management team decided to take action and change the approach to quality. The focus of the strategy was on five key areas:

1. Bring quality on an equal status with safety and programme
2. Improve transparency of off-site activity and quality processes
3. Deploy Quality Delivery Managers (QDMs), QDM Assistants and Independent Inspectors
4. Improve interface management and protect finished assets
5. Employ a forensic team to assist with handback deliverables.

All permanent works of the project were listed and reviewed to ascertain the required Inspection and Test Plans (ITPs), together with timescales and responsibility for their production, approval and acceptance. ITPs were developed for all permanent works activities, including off site manufacture and on-site installation.

Early involvement with the suppliers allowed for robust off-site ITPs and inspections.

**The ‘Quality Strategy’**

The combination of Costain introducing a directive across the business to raise the profile of quality to bring it in line with safety and programme and the LBSR Quality Strategy 2016 led to a successful shift in implementing quality control measures on the project.

The strategy focused on key quality tools that were to be implemented to manage project expectation and to address the key issues highlighted from the Phase 1 audit.

The focus of the project delivery teams needed to be directed towards quality. This was achieved by the implementation of both an increase in quality management resource and
quality training and awareness. In early 2016 a Head of Quality was employed to oversee the implementation of the Quality Strategy and to provide direction to the project.

A Quality Assurance team was created with quality assurance engineers and assistants focusing on managing handover of documentation. The project teams were based around key areas on the project. The addition of a Quality Delivery Manager and an assistant for the eight project teams, with four additional works inspectors was key to the shift to focusing on quality and to bring it on equal status with safety and programme on the project.

**Quality planning – Quality delivery managers/assistants**

Our quality planning tools had to be effective and used adequately during construction – especially Inspection and Test Plans (ITPs) and associated checklists. Timely and accurate quality planning was essential to achieving performance. Costain had a suite of extremely effective processes in place which were used to great success by the project. These included Quality Readiness Reviews (QRRs) held as workshops and attended by stakeholders of the activity for which the QRR was being undertaken.

Quality Readiness Reviews (QRR) utilised the whole team’s experience to identify possible defects that might occur and plan the action required to prevent them. The QRR meetings successfully mitigated the risk of defects occurring by identifying preventative measures. These took place 12 weeks prior to start of construction on site for a given activity,
followed by ITPs which were approved 3 weeks prior to start of construction. The QDMs scheduled and facilitated these workshops.

For any successful project, quality planning must be effective with pre-construction start documentation being prepared, submitted and accepted on time. Timely and accurate quality planning is essential to achieving performance. The QDMs key role was the management of the quality planning of their sections of work, assisting in the preparation of ITPs and Material Approval Requests (MARs), alongside working on the development of a detailed tracker to ensure timely submission of quality documentation. They were also involved in off-site inspections and the auditing of prospective subcontractors / suppliers and monitoring the quality of construction on site.

The Quality Strategy placed additional focus on the QDMs ensuring MARs being in place prior to the start of works on site and that all design is complete allowing a Permission to Commence Construction (PCC) to be approved. Further quality planning and approval tools that were tracked by the QDM assistants included samples for material approval by the Client and the Engineer / Architect and control panels to establish and agree an acceptable quality of installation although these were not required for all packages of work.

QDMs played a key role in ensuring that all quality control was in place before the start of work on site by updating and monitoring quality trackers and chasing documentation which was due soon (amber) before it became overdue (red). Furthermore, these trackers provided indicators for key assurance and milestone dates for submission of assurance information. Using this information, they provided early warning of where there may be problems producing assurance for a handover package on time.

Figure 2 : The Quality Planning Timeline (extract from the LBSR Quality Strategy 2016)
Quality control – Mobile technology (Field View)

The use of mobile tablet computing was driven across the business to drive efficiencies and improve the quality of on-site work.

The primary and business critical objective of introducing mobile technology at London Bridge was to digitise paper-based processes on site, automating workflows and creating a digital audit trail of data collected in context. The digitisation of paper-based processes allows for a standardised approach to forms and how data is collected during project delivery.

Field View was used to electronically capture quality assurance progressively, eliminating the need for paper checksheets, which are often misplaced and are not as easily auditable as the Field View checksheets. It was also used as a snagging tool. The application was in place to ensure progressive verification of the ITP checksheet process electronically, which was not in use during initial installation of the GRC system by the subcontractor.

There was a reluctance to adopt the new technology by some members of the management team, who saw it is irrelevant and a hinderance. The additional quality staff and resource allowed for Field View to be implemented effectively and for the monitoring of progressive assurance. The audit trail provided by field view gave the client confidence in the ITP approval signatures thus allowing for transparent handover of documentation. Individual checksheets were created for GRC panels allowing for the detailed analysis of works and inspection points.

Another area of concern was the increasing number of non-conformances (NCR) that lacked visibility across the relevant project teams. There was a major change on the project in terms of raising and closing out non-conformances. The original paper version was replaced with the Salesforce cloud-based software system, providing analytical tools, email alerts, allowing easy monitoring, traceability, networking, uploading evidence to the NCRs. The phasing out of interdepartmental trackers allowed for collaborative team work.

Quality control – Site inspectors

The team of site quality inspectors were tasked to monitor quality performance of on-site subcontractors and the supervision and snagging of the works. Their key area of success was in visiting each designated subcontractor gang and spending a period of time engaging with the gang, understanding their works at that time, establishing their awareness of QC matters and their compliance with ITP requirements – via QSR process.

This not only allowed for review of suppliers works but also improved the projects relationship with continuous, progressive quality inspections and driving up supply chain performance. The additional inspector resource combined with a site inspection rota involving senior management successfully resolved the concerns over providing quality presence on site for all trades.

Quality training and trade expertise

The Quality Strategy also focused on project delivery teams to be adequately trained to manage and control quality. It proposed taking a pro-active approach to improve engineer familiarity with project specifications, systems and procedures with technical assistance available for specialist areas of works.
The Quality Strategy proposed providing quality training at induction stage. The site induction, which like most projects had no quality content, was revised to include slides on the subject. This was to reinforce the quality culture of the project and was to carry the message that everyone has an influence on the quality of the final product and that all are expected to have pride in their workmanship.

This was supplemented by instructing the quality inspectors to liaise with the site operatives and offering them guidance and coaching. The second new quality induction was for engineering staff and those who needed to follow quality processes on the project. It outlined the processes, the document management system and gave a basic indication of how to find processes and work instructions.

Innovative quality behavioural management training was provided to the newly formed quality team, providing them with the tools required to manage quality behaviours and to understand the impact of environment, antecedents and consequences on modelling quality behaviours.

The LBSR project addressed the concerns over lack of specialist technical knowledge in project teams by employing expert consultants for particular fields of construction, which had been identified as high risk, including national experts to provide expert advice on areas including the supply and installation of glazing, paint and protective coatings, concrete finishing, anodizing and lifts and escalators.

The expert’s prime role was to provide assurance that the correct materials had been purchased and that these had been installed correctly. These individuals were also brought in to give our project staff training and guidance regarding common problems encountered and issues of which to be aware regarding their fields of expertise. These workshops were fundamental in educating the site team on technical matters which proved very beneficial. Together with the QRRs, this training ensured that ITPs and other quality tools were pinpointed towards the actual quality risks. As accurate and effective quality tools, they were well received and better used by staff on site, especially when the consequences of getting it wrong were highlighted. We planned to set up a reference library for latest Specifications and arrange briefings on the specifications. This may have produced additional benefits if fully implemented.

**Quality control – Off-site audits and inspections**

To assist with Quality performance of suppliers and subcontractors being properly managed an off-site inspector was employed, who had experience of project design and quality management. This allowed for the project audit team to focus on site audits whilst the factory audits and quality surveillances were completed by the additional resource. This also allowed the project team to focus on delivery with confidence that the supply chain were producing quality components in line with project specifications and requirements.

Employing a designated off-site auditing/inspection resource was key in eliminating fabrication and rework issues we were facing regularly during the early stages of the project. The project audit schedule was revised to include audits of all key supplier and subcontractor off-site facilities. QDMs agreed aspects of quality high risk with their respective delivery managers, the Quality Manager and Client Engineering staff regarding off-site manufacture in look ahead programmes and target inspections accordingly.
The review and monitoring of off-site manufacture and fabrication ITPs for elements of project works was managed by the QDMs. A key success in eliminating product quality issues was in the identification and positive management of off-site manufacture quality high risk elements throughout the ITP process.

This was prevalent when additional assurance was required by our client in order to close out an NCR and ultimately an assurance pack. The close working relationship with our sub-contractor, a leading steel manufacture, allowed us to conduct a full on-site audit and obtain photo site diaries and inspection records. This allowed the closure of the NCR and assurance pack which meant it could be presented to client.

**Quality assurance**

Assurance of the works undertaken must be collated and accepted progressively – this was an essential requirement in order to reinforce the direction of focus towards quality and ensure we were in a position to deliver to contract requirements. It was identified that the production of timely, concise and accurate assurance for the work delivered was the key to driving quality of product on site. In order to effectively deliver quality on the project, waste in the assurance gathering process needed to be eliminated.

With this in mind, a key duty for the QDMs was to ensure that records were submitted in time and collated correctly and comprehensively. Legacy Assurance tools and documentation must be closed out in order to ensure there is no backlog towards the end of the project which could delay handover.

Additional dedicated assurance staff were deployed, which had a major impact on improvements with collating and delivering handover documentation to the client that was right first time.

**Quality – Snagging and entry into service**

Similarly, there were about 1,200 open items on the Defects and Outstanding Works List (DOWL). Part of the 2016 Quality Strategy included targeting closure of these items to address this backlog and ensure that this problem no longer existed at handover in 2018.

DOWL boards were introduced on site so that site teams could coordinate and close out the issues, specifically prior to entry into service (EIS) of work areas. These were extremely useful in providing the workforce with both a process to increase transparency and a way to expedite verification of the DOWL ready for closure.
Quality control – Forensic team

The Quality Strategy initially required QDMs to carry out in-depth investigations into quality of construction of works on-site. These were known as “Deep Slice” or Forensic Investigations. As the project progressed, a team of forensic engineers was employed to focus on on-going quality problems and emerging issues that were deemed potentially quality critical.

The forensic team adopted comprehensive/ holistic investigations to establish the cause of forensic issues/ failures, allowing for planning of quality remedial actions and a close out of the incident that was acceptable to all stakeholders, including the client.

A key forensic issue on the project was water ingress. The forensic team were responsible for ensuring we had holistic solution to the problem. Engineers assisted the team with date stamped info/photos etc of water ingress issues so that they could gather the most complete history of when and where we had water coming in compared to the state of construction and waterproofing at the platform level. The forensic team, similar to the industry experts provided the client with confidence in project quality risk management.

Lessons learned, reflections and recommendations

The quality issues found during phase one, including the initial install of the GRC panels can be avoided in future by the senior management taking a pro-active approach to quality management.

The project Quality Strategy of employing additional quality resource was critical in ensuring the quality of the final product. The project quality management team was committed to ensuring that staff - as well as partners, subcontractors and suppliers - were fully trained and competent for the tasks they undertook. This reflected in the rapid reduction in outstanding assurance documentation.

Quality advocates should have been present from project conception, during the construction phase (and integrated within the delivery teams, for more effective problem
solving/prevention in real time), right through to project closeout, so that much of their efforts would go into preventing instances like those discussed in this report, rather than being curative.

Most defects in construction require re-work to correct the problem. The longer that any defects remain uncorrected, the more rework is likely to be involved. Defects can be avoided by sufficient planning and monitoring. I feel the project made significant savings by implementing the Quality Strategy in 2016 and thus planning ahead for quality.

The key message from LBSR is that by investing time and resource in planning for quality a project avoids defects and rework.

Whilst corrective actions and lessons learned are invaluable, taking preventive actions is much more time and cost effective and mitigates significant quality events from occurring in the first place. It is obvious in this case that prevention is definitely better than cure when it comes to poor quality management and the costs involved.

The message from LBSR is that if we ‘do it right’ first time we eliminate rework which makes us more efficient, safer and reduces the cost to industry.

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Further information
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